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DIRECTION GÉNÉRALE DES EAUX INTÉRIEURES
OTTAWA, CANADA

Spring runoff forecasting; how much can it be improved by a long-range climate forecast?

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ABSTRACT

The study investigates the application and effectiveness of using long range climate forecast in the spring-runoff forecast. The long range climate forecasts used in this study were the monthly temperature and precipitation forecast maps published in the "Monthly & Seasonal Weather Outlook" by U.S. National Oceanic and Atmospheric Administration. The method and problems associated with the conversion of these monthly temperature and precipitation probabilities into forecast temperature and precipitation values are discussed. The obtained forecast temperature and precipitation values were used as input to several simple multivariate regression models to forecast the spring runoff for five river basins representing different climatic regions in Canada. The six obtained types of the spring runoff forecast results for the five basins are presented, compared and discussed.

1. Introduction

Inland Waters Directorate (IWD) - National Hydrology Research Institute (NHRI) and Water Planning and Management Branch (WP&MB) - in cooperation with Atmospheric Environment Service (AES) have undertaken a study to investigate three main areas:

1) long range climate forecast capability;
2) transfer of information from climate forecast into streamflow forecast;
3) economic evaluation of the improvement of reservoir operation resulting from climate forecast based streamflow forecasts (for the case that long-term climate forecast can be utilized to produce streamflow forecast, which is significantly better than that obtainable by other means, i.e. without the benefit of climate forecast.)

Regarding 1)

Canadian (AES) climate forecast data and the U.S. (Department of Commerce, National Oceanic and Atmospheric Administration-NOAA) climate forecast data were compared. The NOAA data have been used for this study because no Canadian precipitation forecasts were available and because there are problems with interpretability and shortness (only about 7 years) of record for Canadian temperature forecast data. Evaluation of long-term climate forecasts is described in detail in part 3.

Regarding 2)

For the transfer of information from climate forecast into streamflow forecast only simple multivariate regression models were used, and results were evaluated only for the calibration period. We concentrated on snowmelt runoff volume forecast, because this type of forecast could, from the hydrological and statistical viewpoint, most likely yield positive results and, if so, it also would be most important economically.

Forecasting models were tested in different climatic regions represented by the following: the Stikine River and the Upper Place River in British Columbia, the Rainy Lake and the Madawaska Rivers in Ontario and the Mersey River in Nova Scotia (Fig. 1). All five river basins are either regulated by a reservoir system, or a reservoir system is in the planning stage (Stikine). The basin areas and lengths of records used in streamflow modelling are shown in Table 1a; normals for these basins are shown in Table 1b.

TABLE 1a RIVER BASINS UNDER STUDY

	Basin area (km2)	Length of streamflow record (years)
Stikine River	18800	20
Upper Peace River	70200	14
Rainy Lake	19320	65
Madawaska River	2709	19
Mersey River	723	13

TABLE 1b

CLIMATIC NORMALS

(P - precipitation total in mm; T - mean air temperature in °C;

σ - standard deviation)

		MARCH	APRIL	MAY	JUNE	JULY	AUGUST
STIKINE	T			6.1	10.4	12.5	11.6
(DEASE LAKE)	P			23.1	43.6	55.5	52.5
	σT			0.9	1.5	1.3	1.3
	σP			10.3	19.7	28.3	20.2
UPPER PEACE	T			9.1	13.1	15.1	
(DAWSON CREEK A)	P			35.2	72.8	70.8	
	σT			1.1	1.0	1.0	
	σP			30.9	45.0	43.6	
L of W (RAINY LAKE)	T		2.4	10.1	15.7	18.7	
(Dryden)	P		41.6	68.3	95.5	98.9	
	σT		2.1	2.3	1.6	1.4	
	σP		21.8	34.8	30.9	33.3	
MADAWASKA	T	-4.7	3.7	10.5	15.4		
(MADAWASKA)	P	49.4	58.0	62.2	84.9		
	σT	2.7	1.7	1.9	1.2		
	σP	23.4	23.4	27.4	46.2		
MERSEY	T	-0.1	5.1	10.5	15.9	19.1	
(LIVERPOOL	P	122.3	109.3	96.0	75.2	80.3	
BIG FALLS)	σT	1.6	1.4	1.3	1.0	1.2	
	σP	51.8	40.2	87.1	45.9	45.2	

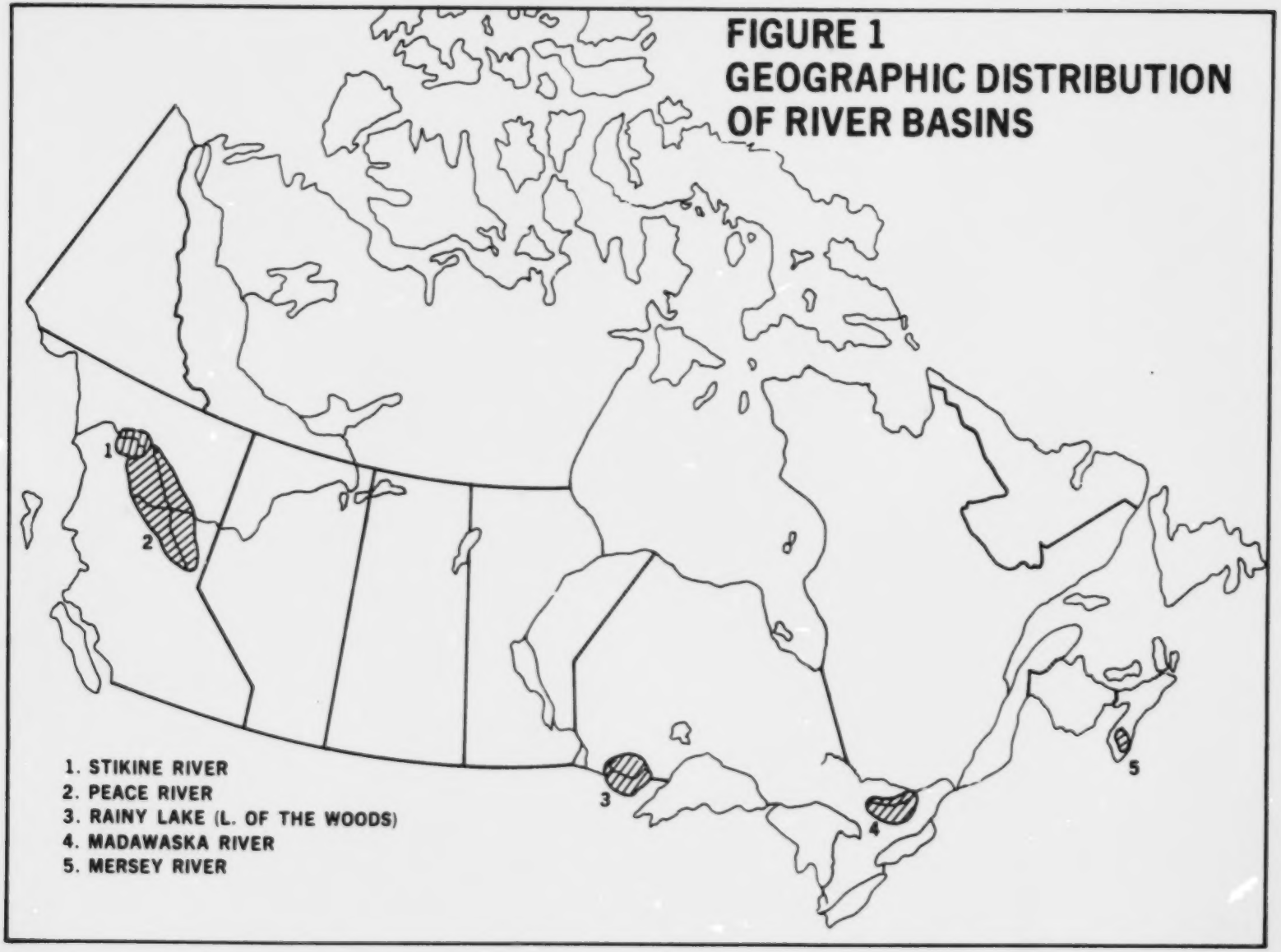


FIGURE 1
GEOGRAPHIC DISTRIBUTION OF RIVER BASINS

For all five river basins several simple multivariate regression models were constructed for streamflow forecast for every month of the period of interest. Only the model giving the best results was used for further testing. For each month two basic types of the model were constructed:

A) no climate forecast (i.e. of precipitation and temperature) available (only recorded temperature and precipitation data available at the time of the forecast are used)

B) forecast of climate is available. Five different types of the simulated climate forecast were considered:

- perfect climate forecast is available (hypothetical limiting case)
- climatic normals are used as forecast
- means over the period of measurement are used as forecast
- actual climate forecast data based on normals are used as forecast
- actual climate forecast data based on means are used as forecast

Types of forecast are discussed in part 2, construction of the models is described in detail in part 4.

Normals (climatic normals) are means calculated for the standardised period of time (1951-1980), means over period of measurement are calculated from historic record available in given basin (see also Table 2).

2. Formulation of the Problem

The objective of this study is the comparison of forecasts of snowmelt runoff without and with climate forecast. We wanted to know the dependence of streamflow totals for April, May, June etc. on specific climatic conditions of the different basins; the forecast lead-time of one month was considered (i.e. on the end of March are calculated streamflow totals for April, etc.). Of course, even without an actual climate forecast there is some information on the streamflow volume available (Fig. 2). The forecast can be based on historical streamflow, temperature and precipitation data available at the beginning of the particular month (i.e. case A - no forecast of climate available) or on historical data and some information on temperature, precipitation and streamflow for the period of forecast (i.e. case B). Still the actual forecast based on normals or on means is even here just one possibility - another possibility is to regard the climatic normals (or means) for the given month directly as the "climatic forecast"; finally, the simplest and basic possibility which requires no modelling at all and no transfer of information from climate variables to streamflow is to regard the monthly streamflow mean as the flow forecast. The latter possibility is always available to the water manager and can serve as a standard for comparison. So the crucial question of the study was, whether the streamflow forecast based on the use of actual long-term climate forecast is significantly better than forecasts available otherwise, and in general, whether and to what extent any flow forecast is superior to the monthly mean flow.

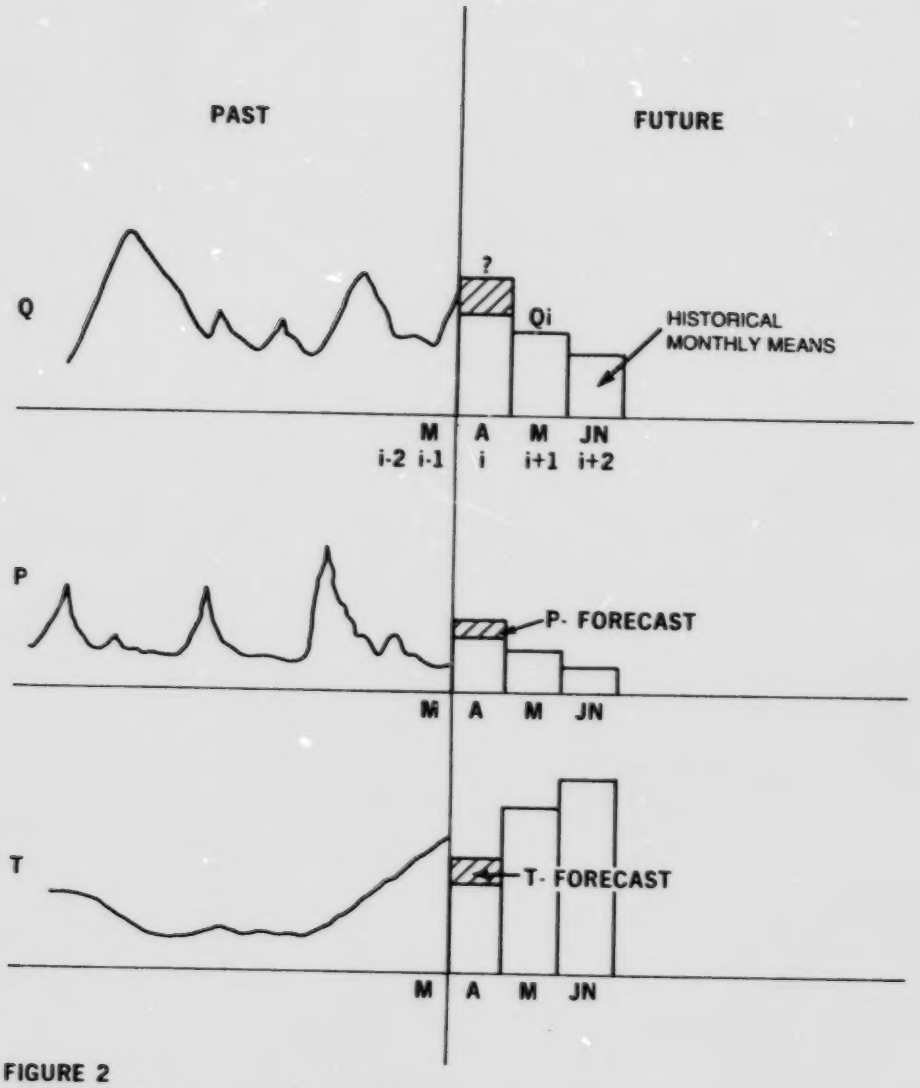


FIGURE 2
INFORMATION ON THE STREAMFLOW VOLUME

The monthly streamflow was forecasted with the aid of the simplest statistical tool - the regression models with the following general structure:

Case A (no climate forecast available):

$$Q_i = a_1Q_{i-1} + a_2Q_{i-2} + a_3Q_{i-3} + \ldots + b_1P_{i-1} + b_2P_{i-2} + b_3P_{i-3} + \ldots + c_1T_{i-1} + c_2T_{i-2} + c_3T_{i-3} + \ldots + d$$

where Q_i , Q_{i-1} are monthly streamflow totals for month i, i-1, ..., P_{i-1},..., are monthly precipitation totals, and T_{i-1},..., are monthly average temperatures and a_1, a_2, ...; b_1, b_2, ...; c_1, c_2, ...; d are constants to be determined.

Case B (with climate forecast):

$$Q_i = a_1Q_{i-1} + a_2Q_{i-2} + a_3Q_{i-3} + \ldots + b_oP_i + b_1P_{i-1} + b_2P_{i-2} + b_3P_{i-3} + \ldots + c_oT_i + c_1T_{i-1} + c_2T_{i-2} + c_3T_{i-3} + \ldots + d$$

where the terms b_oP_i and c_oT_i represent the climate forecast.

As mentioned before these two variables can be represented either by the actual forecasts (conditional means in this study - see later), or by the climatic normals or historic means, or in the hypothetical limiting case of "perfect" (100% correct) forecast, by the true values, which, for calibration period, are available from the historic records.

In summary, the objective of the study is a comparison of different types of climate forecast, as they are stated below:

TABLE 2

TYPES OF CLIMATE FORECAST (used to forecast the streamflow)	Values of T_i and P_i are represented by:	
1 PERFECT FORECAST	Historic data (perfect forecast)	> Limiting Cases
2 NO FORECAST	Zeros (no forecast)	
3 NORMALS USED AS FORECAST	"Normals" taken from NOAA data	> These "forecasts" involve no climate forecasting
4 MEANS USED AS FORECAST	Means calculated from historic records available in given basins	
5 ACTUAL FORECAST BASED ON NORMALS	Conditional means based on NOAA normals	> Forecasts feasible under present conditions
6 ACTUAL FORECAST BASED ON MEANS	Conditional means based on historic means	

3. Present Long-Range Climate Forecast Capabilities

In this study the U.S. (NOAA) precipitation and temperature forecast data are used. NOAA has published the biweekly Monthly and Seasonal Weather Outlook, always one month ahead, since 1963. In this study, data from 1966-1981 were used, most of them (1969-1981) provided by AES Toronto. The rest (1966-1968) were provided by NOAA, Washington, D.C. The published form varies over the years, both graphically and from the viewpoint of information content. Until July 1982 (quotation) "only two categories of average temperature, WARM and COLD, and two of total precipitation, LIGHT and HEAVY, appear on the maps" (see Figure 3). "Each of these classes is defined so as to occur 30 percent of the time in the long run...A third, intermediate category, NEAR NORMAL temperature or MODERATE precipitation.... occurs 40 percent of the time in the long run, and because we (i.e. NOAA) have found that predictive skill lies almost entirely outside this part of the frequency distribution, its probability is kept at a constant and uniform 40 percent" (end of quotation). (For precipitation, though, for some time there was no MODERATE precipitation defined, just the line of indifference). Since 1981 (quotation) "the map... shows a probability for the preferred class" (Figure 4). For temperature, NOAA supposes that the probability distribution will be approximately Gaussian, for precipitation no recommendation is provided. In this study, Gamma (Pearson III) probability distribution is used for precipitation, because in the absence of data it is considered the best bet. The probabilities of

average monthly weather outlook

US DEPARTMENT OF COMMERCE-National Oceanic and Atmospheric Administration-National Weather Service

FOR OCTOBER 1975

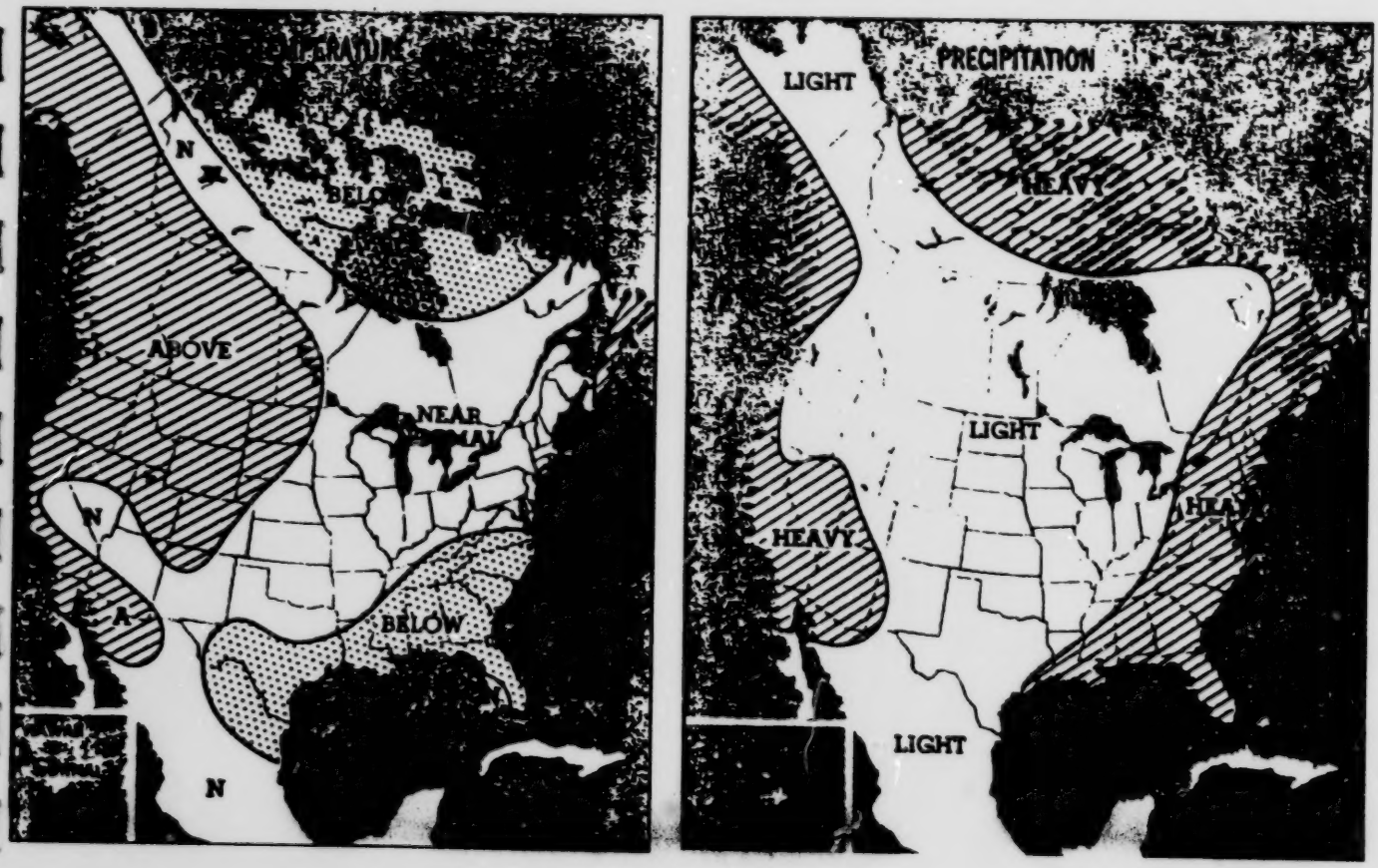


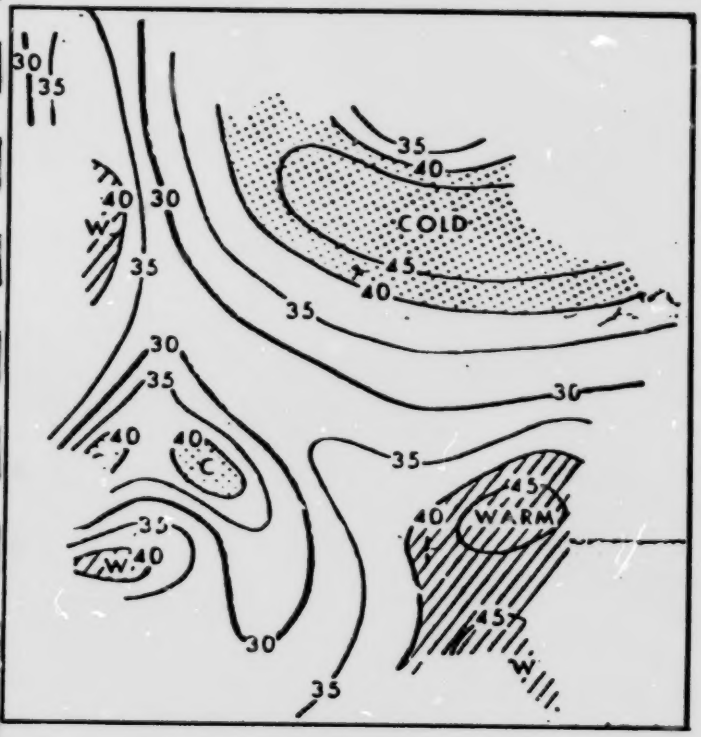
FIGURE 3

NOAA LONG-TERM CLIMATE FORECAST MAP – EXAMPLE

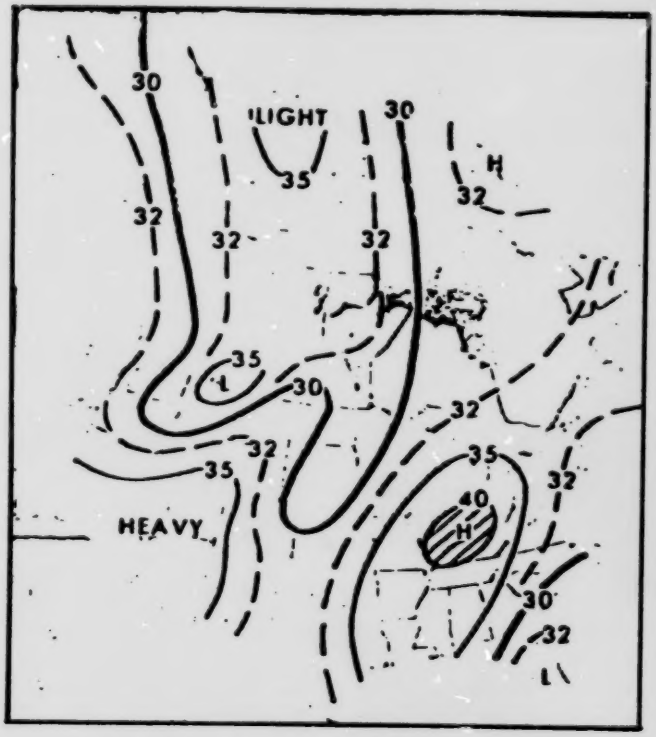
MONTHLY & SEASONAL WEATHER OUTLOOK

US DEPARTMENT OF COMMERCE-National Oceanic and Atmospheric Administration-National Weather Service

FOR MID-DECEMBER 1982 TO MID-JANUARY 1983



TEMPERATURE PROBABILITIES



PRECIPITATION PROBABILITIES

FIGURE 4

NOAA LONG-TERM CLIMATE FORECAST MAP - EXAMPLE

occurrence 0.3:0.4:0.3 are considered in this study both for temperature (COLD:NEAR NORMAL:WARM) and precipitation (LIGHT:MODERATE:HEAVY). NOAA forecasts for the five river basins under study are summarized in Appendix 1.

Now we have to evaluate, what the forecast says about 'non-normal' situations. Let us deal first with temperatures. Their forecast is considered to be more reliable and, because their probability distribution is supposed to be Gaussian, the calculation of the conditional distributions is simple. The normal situation for temperatures is shown in Fig. 5, where μ is mean and T_c, T_w are threshold values for 'cold' and 'warm' temperatures, respectively.

Four basic possibilities are considered (with respect to NOAA maps):

- temperature will be 'cold' - there is a 40 percent chance, that the average monthly temperature will be lower than the threshold value T_c for low temperatures. There is still a 40 percent probability that the temperature will be normal, and a 20 percent chance that the temperature will be high. Thus for COLD:NEAR NORMAL:WARM the probabilities are 0.4:0.4:0.2, respectively.

- temperature will be 'very cold' - the chance that the temperature will be below T_c is 50 percent, so that there is a 10 percent chance that the temperature will be above T_w, since the probability of near normal temperature is kept at 0.4. We can thus write COLD:NEAR NORMAL:WARM 0.5:0.4:0.1.

In the same way, we can write

- warm
  COLD:NEAR NORMAL:WARM 0.2:0.4:0.4 and

- very warm
  COLD:NEAR NORMAL:WARM 0.1:0.4:0.5

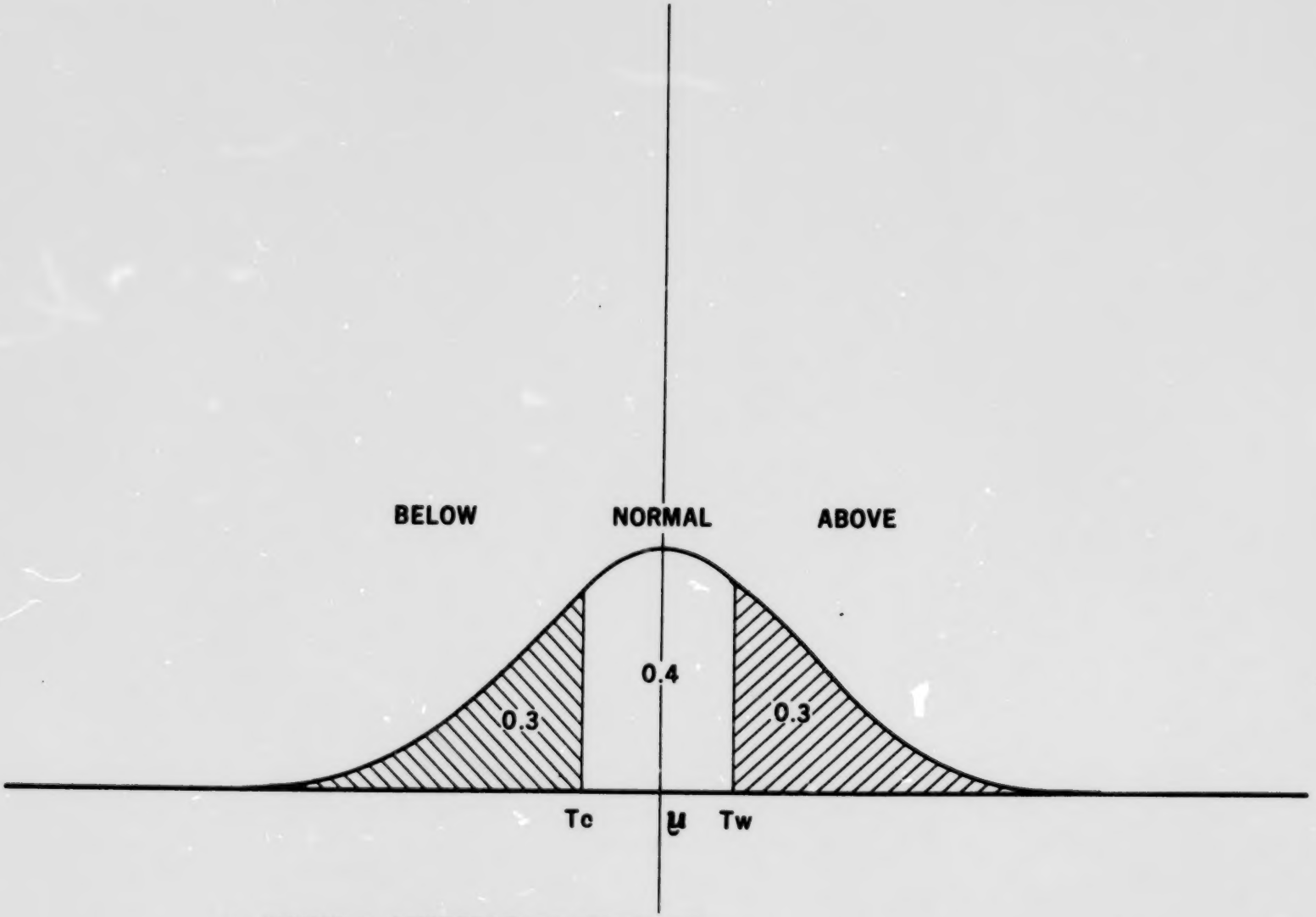


FIGURE 5 TEMPERATURE FORECAST
PROBABILITY DISTRIBUTION FOR THE "NEAR NORMAL" SITUATION

(See Figures 6a, b, c, d).

One should note that, even for the extreme situations 'very cold' or 'very warm' as defined above the values of conditional means μ_{vc} and μ_{vw} do not exceed the threshold values T_c and T_w, respectively; thus even here the conditional means belong in fact in NEAR NORMAL category.

For precipitation (Figure 7) the situation is similar; the only difference being that for LOW precipitation one can expect the total monthly precipitation to be smaller that the threshold value P with a probability of 35 percent and for VERY LOW precipitation with a probability of 40 percent. Four basic types of 'non-normal' situations can be then described as follows:

	LIGHT:MODERATE:HEAVY
- VERY LOW	0.40 : 0.4 : 0.20
- LOW	0.35 : 0.4 : 0.25
- HIGH	0.25 : 0.4 : 0.35
- VERY HIGH	0.20 : 0.4 : 0.40

As mentioned earlier, conditional means were used as long range climate forecast (variables T_o and P_o) in the regression model. Calculation of conditional means depends on the situation for every specific month for every river basin. For temperatures, the computation is relatively simple; it can be computed either directly from basic principles (for known values μ and σ of normative normal distribution and for known

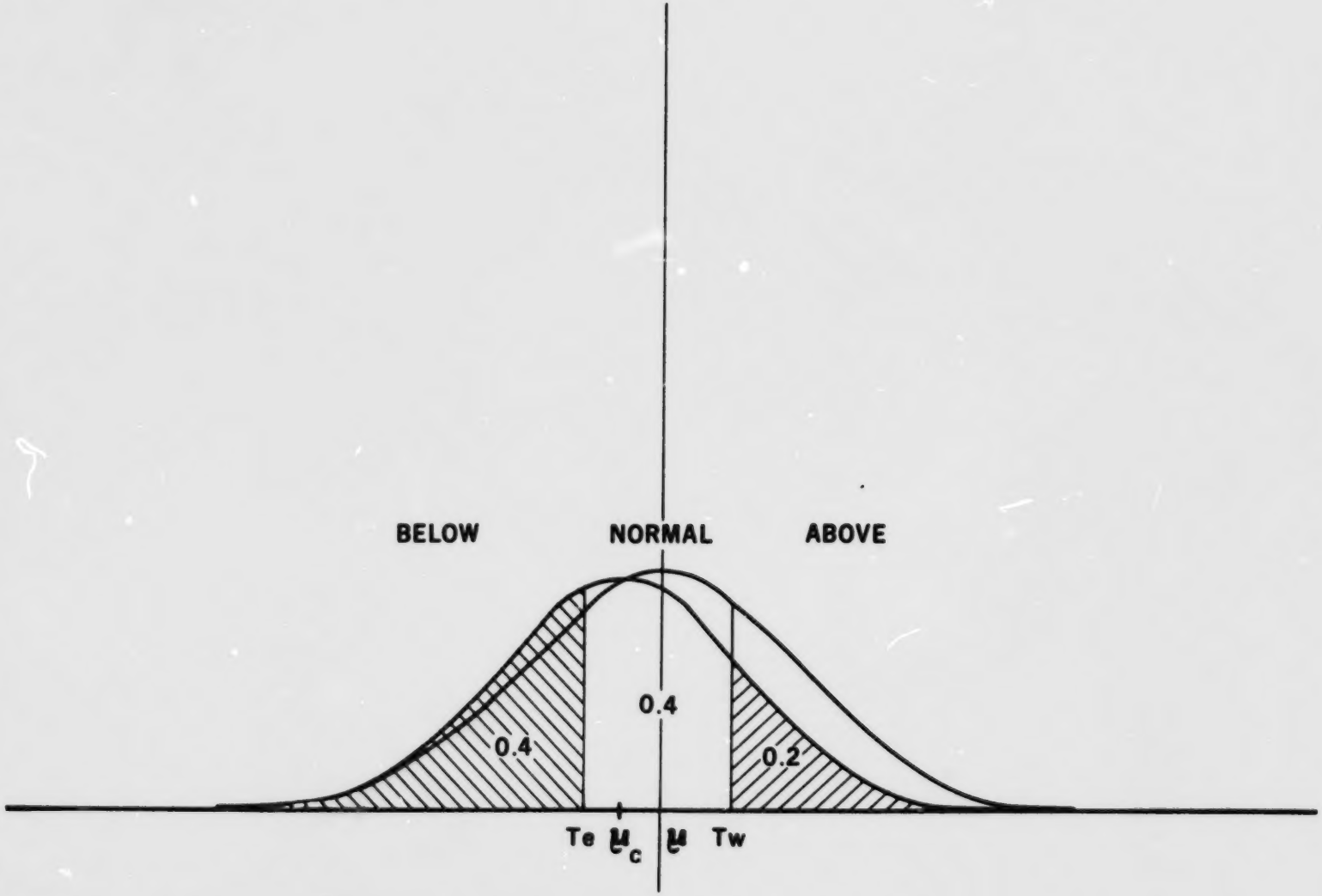


FIGURE 6a TEMPERATURE FORECAST
PROBABILITY DISTRIBUTION FOR THE "COLD" SITUATION

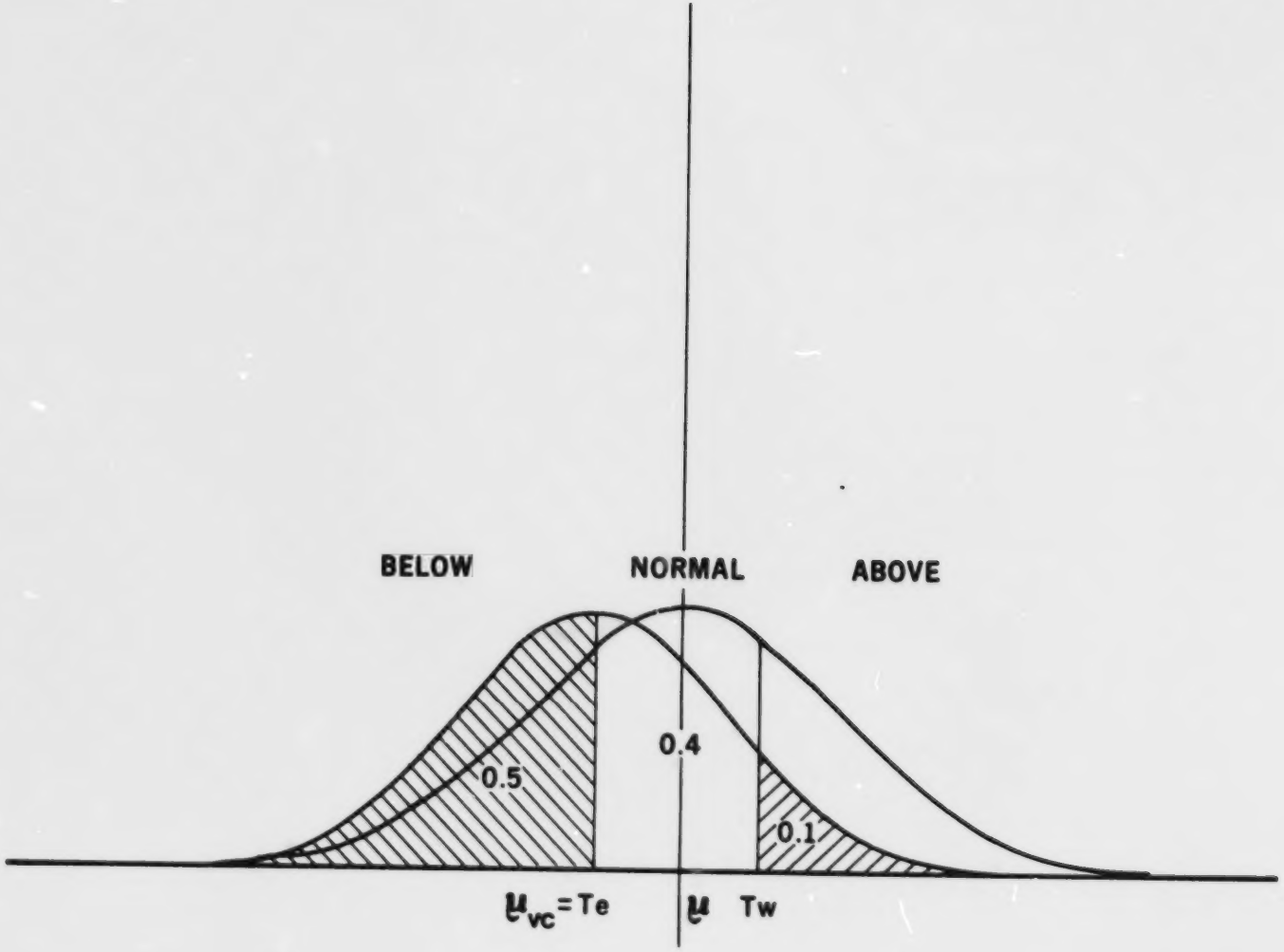


FIGURE 6b TEMPERATURE FORECAST
PROBABILITY DISTRIBUTION FOR THE "VERY COLD" SITUATION

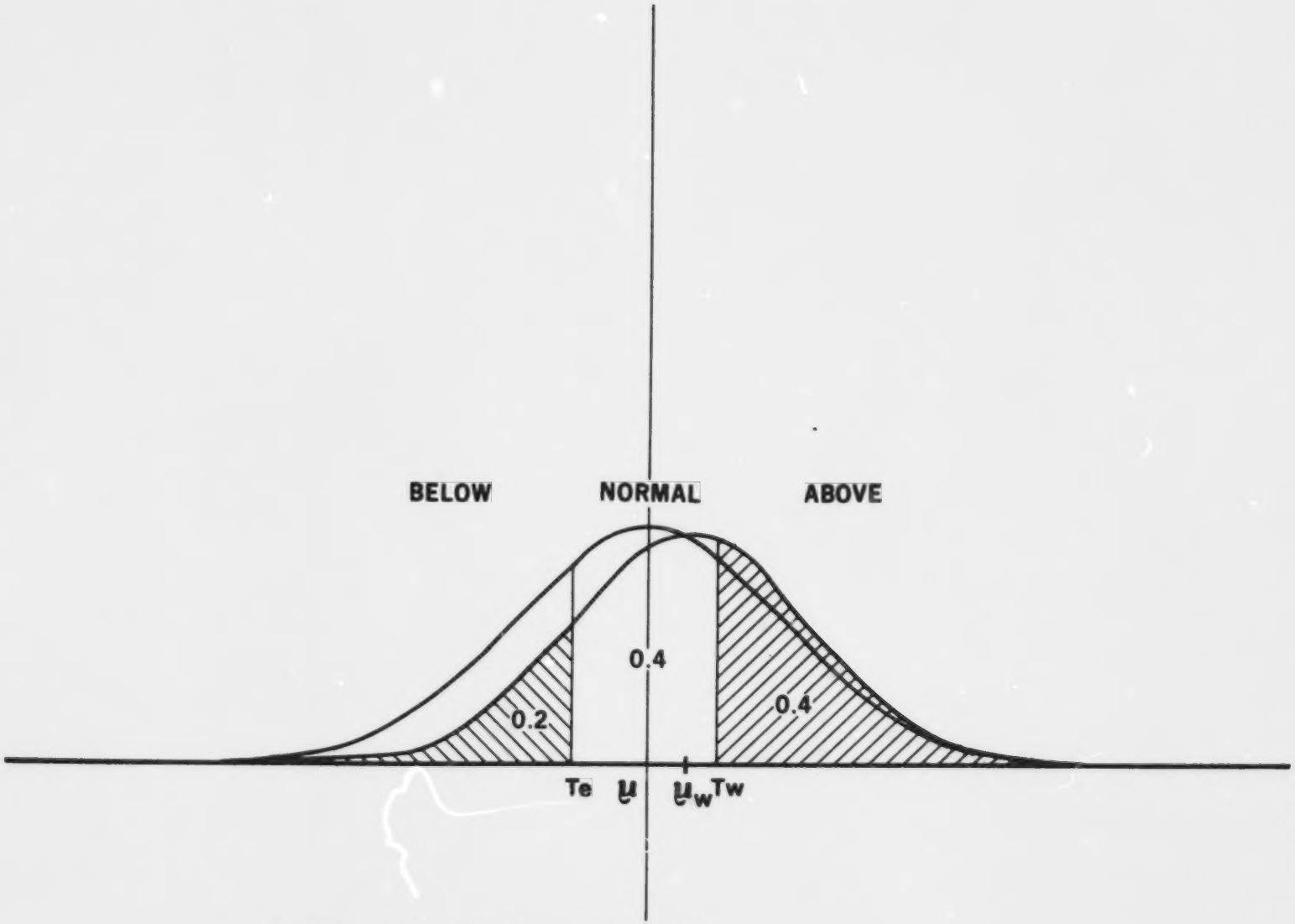


FIGURE 6c TEMPERATURE FORECAST
PROBABILITY DISTRIBUTION FOR THE "WARM" SITUATION

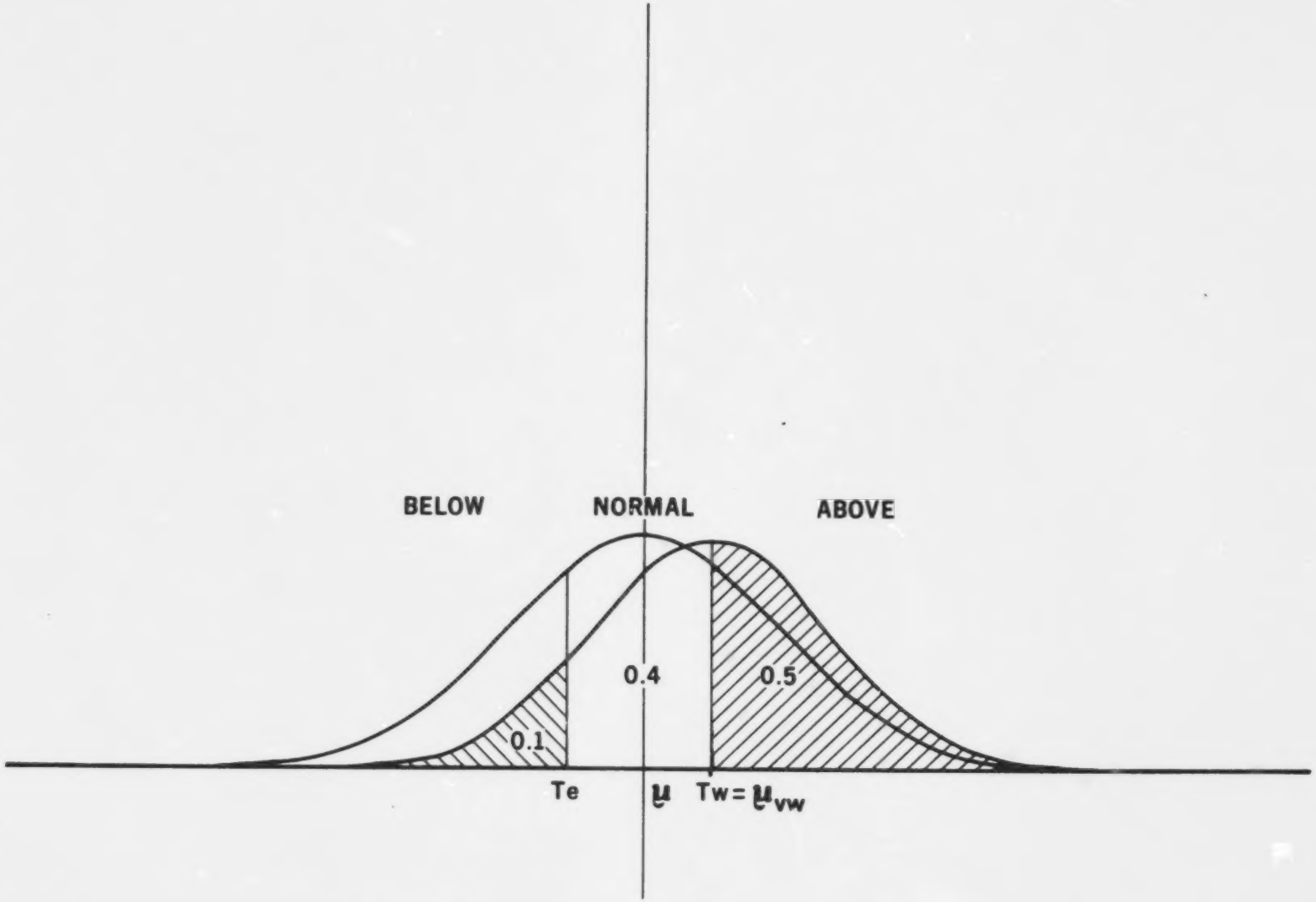


FIGURE 6d TEMPERATURE FORECAST
PROBABILITY DISTRIBUTION FOR THE "VERY WARM" SITUATION

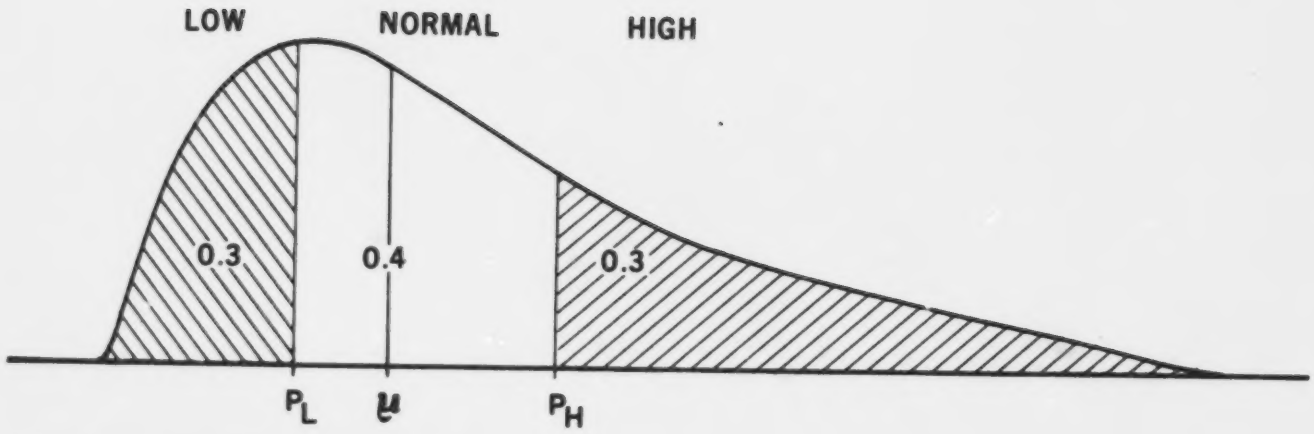


FIGURE 7 PRECIPITATION FORECAST
PROBABILITY DISTRIBUTION FOR THE "NORMAL" (="MODERATE") SITUATION

probability distribution, values T_c and T_w are calculated and then, because T_c and T_w are constant, for the changed probability distribution new (conditional) μ (and σ, if requested) are calculated) or using precomputed coefficients given by NOAA to simplify the procedure.

NOAA approach is described in the 'Average Monthly Weather Outlook':

"Some users may wish to have a complete probability distribution, from which their own choice of classes can be assigned probabilities. For temperature, that conditional probability distribution will be approximately Gaussian, and its mean and standard deviation can be estimated for the desired location by adjusting the local normal and class limits with the help of the following table:

30	.00	1.91
35	.27	1.90
40	.53	1.86
45	.77	1.81
50	1.00	1.74

For a predicted percent probability of WARM or COLD in the first column, the mean of the conditional distribution will be the local normal plus or minus the product of the local class limit threshold value and the factor given in the second column. The standard deviation of the conditional distribution will be the product of the same class limit threshold value and the factor given in the third column. These adjustments amount to a shifting and slight narrowing of the climatic frequency distribution of monthly or seasonal average temperatures. Unfortunately, since its

climatic frequency distribution is not Gaussian, the same kind of simple generalization of the forecast probabilities cannot be provided for precipitation."

In this study, conditional means (i.e. quantified values of temperature forecast) were calculated for each river basin, each month; results are summarized in Appendix 2.

However, as an input into the regression model results obtained with the help of NOAA method were used. Appendix 2 contains also limit values T_C, T_W (for temperatures) and P_L, P_H (for precipitation) for all five river basins.

Calculation of conditional precipitation means was more complicated. To avoid increase of σ for conditional Gamma distributions (which could decrease the exactness of forecast), the same ratio σ unconditional/ σ conditional was assumed for the precipitation distributions as it was obtained for the Gaussian temperature distribution (the increase of σ for precipitations can hardly be smaller than the increase of σ for temperature). Then, only one threshold value (either P_L for LOW and VERY LOW precipitation, or P_H for HIGH and VERY HIGH precipitation) is considered constant, the other is flexible. For $C_S = 2C_V$, conditional means were calculated and the results are also summarized in Appendix 2.

Conditional means for both temperature and precipitation forecasts for all five river basins are summarized (cases which appear in 1966-1981 period) in Appendix 3. Appendix 3 shows the first and the most important conclusion of this study: conditional means for 'extreme' situations differ very little from those for the 'normal' situation: conditional means differ by several tenths of °C for temperatures and usually by several millimeters for precipitation. Results for conditional means based on normals show, too, that climatic normals sometimes don't correspond with means for shorter periods of time (10-15 years), results obtained with the same model are often better for actual forecasts based on data than for actual forecast based on normals (these results are also summarized in Appendix 3). For more clear illustration, relative values of both conditional means based on climatic normals and conditional means based on means are shown; in other words, what is shown are differences from climatic normals.

4. Construction of the model

The objective was to transfer the information obtained from climate forecast into information on streamflow volume. As a first step, a simple multivariate regression model was used, and evaluated for the calibration period (although the models were also tested as a forecasting tool for two river basins out of five).

Two types of multivariate regression models were developed (type A, no climate forecast available, and type B, with climate forecast) as was described on page 5.

The dependent variable was the monthly total of streamflow.

We concentrated on the forecast of snowmelt-caused streamflow, and we wanted the determination of the dependence of streamflow volumes for the months of April, May, June, etc., on specific climatic conditions in the different basins.

The forecast time-lag was one month and the forecast was always conducted one step ahead, so that the forecast of streamflow at the beginning of May was based on hydrometeorological information available at the beginning of April (case A) or on hydrometeorological information and the forecast available at the beginning of April (case B) and so on. At the end of each month, the forecast was compared with reality and updated for the next forecast.

For the five river basins considered the goal was to forecast the volume of monthly runoff at the beginning of the month as follows:

(1) For the Stikine River above the Grand Canyon: on May 1, June 1, July 1 and August 1,
(2) For the Upper Peace River at Hudson Hope: on May 1, June 1, July 1,
(3) For Rainy Lake (the Lake of the Woods system): on April 1, May 1, June 1, July 1,
(4) For the Madawaska River at Bark Lake Dam: on March 1, April 1, May 1, June 1, and
(5) For the Mersey River at Milton: on April 1, May 1, June 1, July 1.

Data

The structure of data sets for all five river basins was as follows:

Historical streamflow, precipitation (eventually snow cover) and temperature data were used as independent variables. The streamflow data sets used consisted of monthly streamflow volume Q_i (for the i-th month), average monthly streamflow volumes $\bar{Q}_i$, and deviations $QI = Q_i - \bar{Q}_i$, in mm/month. These data were prepared with the help of the Water Planning and Management Branch. Cooperation has also been requested (and all necessary data obtained) from B.C. Hydro, the Nova Scotia Power Corporation, Ontario Hydro and the Lake of the Woods Control Board. The temperature data sets consisted of monthly mean temperatures T_i for the i-th month, average monthly temperatures over the period of interest, $\bar{T}_i$, climatic normals for 1951-1980 period TN_i and deviations $TI = T_i - \bar{T}_i$ or $T_i - TN_i$, always in °C.

The precipitation data set contains P_i (monthly sum of total precipitation) $\bar{P}_i$ (average monthly precipitation) and PN_i (monthly normals calculated from 1951-1980 period), in mm for i-th month, and $PI = P_i - \bar{P}_i$ or $P_i - PN_i$.

Temperature and precipitation data were supplied by Atmospheric Environment Service, Toronto.

In this study, the goal was to estimate, how deviations of temperature and precipitation from their means (COLD, WARM temperature, LOW, HIGH precipitation) influence the streamflow deviation. Therefore, in calculations summarised in this study, deviations QI, TI and PI are used as an input data.

To consider specific precipitation conditions during the winter period, two types of precipitation values were used

-monthly values $PI = P_i - \bar{P}_i$ or

$PI = P_i - PN_i$ (see page 25)

or

-values $PSI = \sum^{i} P_i - \sum^{i} \bar{P}_i$ or

$PSI = \sum^{i} P_i - \sum^{i} PN_i$ thus

$PSI = \sum^{i} PI$

for the period of interest (from October or November till February, March, April, depending on local climatic conditions).

Models

For each month of interest for each river basin, 3 to 4 different type B models (with forecast) and 2 to 3 different models of type A (without

forecast) were tested. For type B-forecasts, the limiting case of the 'perfect' forecast was applied and for both A and B cases, r-coefficients and F-tests were evaluated. For the definitions, see for example Snedecor and Cochrane (1980). The structure of final ("best") prediction equations is described in Appendix 4. Then, for both A and B cases, the set of regression coefficients was applied for the whole calibration period and for different types of climate forecast, as they are described on page 9, i.e., the regression coefficients for #1 forecast (PERFECT FORECAST) are used also for forecasts #3-6 (NORMALS USED AS FORECAST etc.).

Appendix 5 provides an example showing how individual types and combinations of forecast were calculated for the Upper Peace during May. Calculations were supported by the SPSS package of statistical programs.

5. Results and Conclusions

Results obtained for all scenarios considered in this study are summarized in Tables 3a-3e, 4a-4e and 5 and in Appendix 6. Combinations corresponding with reality for particular month and particular river basin were used as inputs for forecast numbers 3, 4, 5 and 6, Temperature and precipitation 'probability' columns in Appendix 6 use probabilities tabulated in Appendix 1 (NOAA Precipitation and Forecast data). The 'combination' column corresponds with the table 'Types of Forecast' from Appendix 1. For example, combination 11 means that for each river basin and each month, the forecast for both temperature and precipitation expects 'normal' conditions, with probability distribution 0.3:0.4:0.3 (see part 3 of this study). For this combination results are identical for NORMALS USED AS FORECAST (#3) forecast and IMPERFECT (ACTUAL) FORECAST BASED ON NORMALS (#5 forecast). Results are also identical for MEANS USED AS FORECAST (#4) and IMPERFECT (ACTUAL) FORECAST BASED ON MEANS (#6). Improvements of F-test and r values with the increasing length of record were tested as well. The example for the Stikine River for May is illustrated by Appendix 7. An illustration of results for the Peace River is given in Appendix 8. It shows, that so called NO FORECAST (#2) gives often better results than IMPERFECT (ACTUAL) FORECAST BASED ON NORMALS (#5 forecast).Examples showing graphical comparison of six types of streamflow forecast with the measured streamflow are shown in Appendix 9. Comparisons of the six forecast versions with reality considering standard deviations σ

(for spread comparison) and r - coefficients (for closeness of fit) and the F-test are summarized in Tables 3a - 3e. Table 4a - 4e and Table 5 indicate how often the actual forecast based on normals is better than other forecasts available.

The 100 percent forecast (PERFECT FORECAST) gives the best results. On the other hand, the currently available actual forecast, i.e. the IMPERFECT FORECAST BASED ON NORMALS (#5 forecast see page 59) is only rarely better than forecasts #2, 3 and 4 (NO FORECAST, NORMALS USED AS FORECAST, MEANS USED AS FORECAST, respectively).

The standard deviation of the measured Q was used as a measure of the quality of the forecast. This method yields indicates that the other results are no worse than these for the #5 forecast.

Two main results of this study are:

1) The NOAA forecasts contain little hardcore information. Conditional monthly means for temperature and precipitation differ by too small an amount to be significant. The assumption by NOAA that the "...intermediate category, NEAR NORMAL temperature or MODERATE precipitation...occurs 40 percent of the time the long run" means that all forecasts can almost be considered as "normal" and they are therefore of little practical use.
2) NOAA data on long-term forecast of temperature and precipitation hardly improve streamflow forecasts. Long-term means and climate normals result in basically the same forecast.

At this stage, no economic evaluation of benefits obtainable with the help of currently obtainable actual climate forecast is necessary. The climate forecast does not improve the streamflow forecast and this is the basis for increasing the efficiency of reservoir operation.

However, only simple multivariate regression models have been tested to date. A next step already in progress will involve the simulation of spring runoff forecast with the help of the conceptual non-linear regression (Tsykin) model. The complementary relationship areal evapotranspiration (CRAE-Morton) model will also be tested. Both these two models will be applied on one or two previously studied river basins (probably Stikine and Peace in British Columbia in the case of Tsykin model and Rainy Lake in the case of CRAE model).

Table 3a SIX FORECAST VERSIONS - COMPARISON
STIKINE

Month	Method of Q-Prediction	Q Measured	100% Forecast	No Forecast	Normals Used as Forecast	Means Used as Forecast	IF based on Normals	IF based on Means
May	σ	14.87	7.19	11.91	12.23	11.97	12.43	12.04
	r		0.7562**	0.4697	0.2936	0.2957	0.2822	0.2896
	F-test		3.739*	1.510	0.7181	0.5702	0.7545	0.5946
June	σ	33.42	21.80	27.05	34.22	33.76	33.71	32.71
	r		0.7604*	0.5122*	0.3806	0.3808	0.4217	0.4231
	F-test		1.844	0.771	0.6119	0.6439	0.6180	0.6495
July	σ	29.02	11.70	12.53	12.47	12.42	12.38	12.39
	r		0.9280**	0.9027*	0.8833**	0.8833**	0.8840**	0.8844**
	F-test		6.052**	5.585**	1.3317	1.3267	1.4091	1.4000
August	σ	15.55	6.94	9.13	11.32	11.25	11.28	11.20
	r		0.9080**	0.8536*	0.6865	0.6860	0.6996	0.6983
	F-test		3.416*	2.983	3.3740	0.3861	0.3967	0.4095

Q-Predicted

* significant at 95%
** significant at 99%
IF ~ imperfect forecast

TABLE 3b SIX FORECAST VERSIONS-COMPARISON
UPPER PEACE

Month	Method of Q-Prediction	Q Measured	100% Forecast	No Forecast	Normals Used as Forecast	Means Used as Forecast	IF based on Normals	IF based on Means
May	σ	9.96	5.94	8.83	10.36	10.19	9.87	9.78
	r		0.8040**	0.4652	0.2990	0.2996	0.3210	0.3198
	F-test		2.9266	0.9211	0.7101	0.6779	0.5708	0.5385
June	σ	11.99	6.95	7.01	7.08	7.07	7.06	7.07
	r		0.8147**	0.8118**	0.8081*	0.8085*	0.8093*	0.8085*
	F-test		1.2350	2.2552	1.2719	1.2857	1.2917	1.2833
July	σ	11.06	4.24	5.41	18.99	18.76	20.09	20.08
	r		0.9237**	0.8723**	0.7323	0.7327	0.7068	0.7033
	F-test		1.745	1.989	0.5492	0.5474	0.5212	0.5142

Q-Predicted

* significant at 95%
** significant at 99%
IF ~ imperfect forecast

TABLE 3c SIX FORECAST VERSIONS - COMPARISON
RAINY LAKE

Month	Method of Q-Prediction	Q Measured	100% Forecast	No Forecast	Normals Used as Forecast	Means Used as Forecast	IF Based on Normals	IF Based on Means
April	σ	22.62	14.27	13.26	13.75	13.85	14.63	13.26
	r		0.990**	0.92**	0.92**	0.91**	0.89*	0.85*
	F-test		3.658*	6.345**	3.587*	3.602*	2.883	2.589
May	σ	31.92	26.05	24.82	24.25	24.26	24.91	24.44
	r		0.89**	0.85**	0.85**	0.85**	0.84**	0.85**
	F-test		3.779*	4.456*	2.419	2.404	2.447	2.469
June	σ	37.86	30.55	30.51	31.28	31.15	31.33	31.33
	r		0.94**	0.94**	0.94**	0.94**	0.94**	0.94**
	F-test		2.604	4.369*	2.640	2.575	2.654	2.579
July	σ	33.19	26.31	24.67	29.94	24.96	25.15	25.16
	r		0.98**	0.87**	0.88**	0.88**	0.88*	0.88**
	F-test		0.388	0.788	0.362	0.360	0.377	0.378

Q-Predicted

* significant at 95%
** significant at 99%
IF ~ imperfect forecast

TABLE 3d SIX FORECAST VERSIONS-COMPARISON MADAWASKA

Month	Method of Q-Prediction	Q Measured	100% Forecast	No Forecast	Normals Used as Forecast	Means Used as Forecast	IF based on Normals	IF based on Means
March	σ	21.69	11.67	18.21	9.05	8.95	10.27	9.98
	r		0.83**	0.50*	0.46	0.37	0.48	0.41
	F-test		4.928*	1.683	0.451	0.424	0.608	0.539
April	σ	30.72	26.37	22.11	21.09	21.19	21.85	21.87
	r		0.85*	0.70**	0.61*	0.61*	0.65*	0.65*
	F-test		2.540	1.687	0.739	0.710	0.873	0.839
May	σ	42.80	40.14	35.14	37.33	37.34	36.34	36.26
	r		0.94**	0.82**	0.71*	0.71*	0.72*	0.72*
	F-test		4.840*	2.355	0.991	0.991	0.959	0.967
June	σ	14.65	13.39	12.99	10.75	10.82	10.81	10.94
	r		0.90**	0.88**	0.85**	0.8**	0.83*	0.83*
	F-test		2.629	3.323	0.910	1.014	0.863	0.953

Q-Predicted

* significant at 95%
** significant at 99%
IF ~ imperfect forecast

TABLE 3e SIX FORECAST VERSIONS- COMPARISON
MERSEY

Month	Method of Q-Prediction	Q Measured	100% Forecast	No Forecast	Normals Used as Forecast	Means Used as Forecast	IF based on Normals	IF based on Means
April	σ	33.08	32.54	32.90	33.00	32.96	33.18	33.11
	r		0.1986	0.1316	0.1213	0.1213	0.0785	0.085
	F-test		0.0831	0.0881	0.0362	0.0.0316	0.0363	0.0328
May	σ	42.56	34.59	33.32	38.26	38.03	38.66	38.51
	r		0.7495*	0.6311*	0.4778	0.4778	0.4621	0.4621
	F-test		1.282	1.324	0.5373	0.5456	0.5316	0.5417
June	σ	18.99	12.16	15.19	26.93	25.33	28.27	27.27
	r		0.9104*	0.7103*	0.2163	0.2163	0.1641	0.1636
	F-test		1.613	0.727	0.2471	0.2357	0.2404	0.2340
July	σ	32.86	12.07	14.64	17.21	16.77	16.64	16.78
	r		0.9046*	0.8869**	0.8693	0.8802	0.8816	0.8816
	F-test		1.893	1.900	0.4052	0.4235	0.4307	0.4224

Q-Predicted

* significant at 95%
** significant at 99%
IF ~ imperfect forecast

TABLE 4a

ACTUAL FORECAST BASED ON NORMALS-EVALUATION

STIKINE

ACTUAL FORECAST BASED ON NORMALS IS SIGNIFICANTLY BETTER THAN

	σ	r
FORECAST #2 (NO FORECAST)*	0 x	0 x
#3 (NORMAL USED AS FORECAST)	0 x	1 x
#4 (MEANS USED AS FORECAST)	0 x	1 x
Q-MEASURED	2 x	

4 cases considered

* see page 9, table 2

TABLE 4b

ACTUAL FORECAST BASED ON NORMALS - EVALUATION

UPPER PEACE

ACTUAL FORECAST BASED ON NORMALS IS SIGNIFICANTLY BETTER THAN

	σ	r
FORECAST #2 (NO FORECAST)	0 x	0 x
#3 (NORMAL USED AS FOR FORECAST)	0 x	0 x
#4 (MEANS USED AS FORECAST)	0 x	0 x
Q-MEASURED	1 x	

3 cases considered

TABLE 4c

ACTUAL FORECAST BASED ON NORMALS - EVALUATION

RAINY LAKE
(LAKE OF THE WOODS)

ACTUAL FORECAST BASED ON NORMALS IS SIGNIFICANTLY BETTER THAN

	σ	r
FORECAST #2 (NO FORECAST)	0 x	0 x
#3 (NORMALS USED AS FORECAST)	0 x	0 x
#4 (MEANS USED AS FORECAST)	0 x	0 x
Q-MEASURED	3 x	

4 cases considered

TABLE 4d

ACTUAL FORECAST BASED ON NORMALS - EVALUATION

MADAWASKA

ACTUAL FORECAST BASED ON NORMALS IS SIGNIFICANTLY BETTER THAN

	σ	r
FORECAST #2 (NO FORECAST)	1 x	0 x
#3 (NORMAL USED AS FORECAST)	0 x	0 x
#4 (MEANS USED AS FORECAST)	0 x	1 x
Q-MEASURED	4 x	

4 cases considered

TABLE 4e

ACTUAL FORECAST BASED ON NORMALS - EVALUATION

MERSEY

ACTUAL FORECAST BASED ON NORMALS IS SIGNIFICANTLY BETTER THAN

	σ	r
FORECAST #2 (NO FORECAST)	0 x	0 x
#3 (NORMALS USED AS FORECAST)	0 x	0 x
#4 (MEANS USED AS FORECAST)	0 x	0 x
Q-MEASURED	1 x	

4 cases considered

TABLE 5

ACTUAL FORECAST BASED ON NORMALS - EVALUATION

ALL FIVE RIVER BASINS

ACTUAL FORECAST BASED ON NORMALS IS SIGNIFICANTLY BETTER THAN

	σ	%	r	%
FORECAST #2 (NO FORECAST)	1 x	5.3	0 x	0
#3 (NORMALS USED AS FORECAST)	0 x	0	1 x	5.3
#4 (MEANS USED AS FORECAST)	0 x	0	2 x	10.5
Q-MEASURED	12 x	63.2		

19 cases considered

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APPENDIX 1

NOAA PRECIPITATION AND TEMPERATURE FORECAST DATA FOR:

Stikine
Upper Peace
Rainy Lake
Madawaska
Mersey

TYPES OF FORECAST

TEMPERATURES		PROBABILITY DISTRIBUTION	ABBREVIATION[1]
TYPE OF FORECAST			
1. Normal	(N)	0.3 : 0.4 : 0.3	N
2. Cold	(C)	0.4 : 0.4 : 0.2	0.4C
3. Warm	(W)	0.2 : 0.4 : 0.4	0.4W
4. Very Cold	(VC)	0.5 : 0.4 : 0.1	0.5C
5. Very Warm	(VW)	0.1 : 0.4 : 0.5	0.5W

PRECIPITATIONS		PROBABILITY DISTRIBUTION	ABBREVIATION
TYPE OF FORECAST			
1.Normal (Moderate)	(N,M)	0.3 : 0.4 : 0.3	N
2. Low	(L)	0.35: 0.4 : 0.25	0.35L
3. High	(H)	0.25: 0.4 : 0.35	0.35H
4. Very Low	(VL)	0.4 : 0.4 : 0.2	0.4L
5. Very High	(VH)	0.2 : 0.4 : 0.4	0.4H

NOTES

T_C, T_W - temperature threshold value (cold, warm, respectively)

P_L, P_H - precipitation threshold value (low, high, respectively)

1) see Appendix 2

STIKINE

YEAR	MAY		JUNE		JULY		AUGUST	
	TEMP	PREC	TEMP	PREC	TEMP	PREC	TEMP	PREC
1966	N	L	N	M	C	H	N	M
1967	C	M	W	L	W	M	W	M
1968	N	M	N	H	N	M	W	L
1969	N	M	W	L	N	L	N	M
1970	N	M	W	M	C	H	N	L
1971	N	H	W	L	C	H	W	L
1972	VC	L	N	H	C	H	C	M
1973	W	M	N	H	N	M	W	M
1974	W	L	W	L	N	H	N	H
1975	N	L	L	H	N	H	W	H
1976	W	M	W	H	N	H	N	L
1977	W	L	N	H	W	H	N	H
1978	W	L	N	H	W	L	N	L
1979	N	L	N	L	N	H	N	H
1980	W	H	W	L	N	H	N	L
1981	N	H	N	H	C	H	W	L
1982	N	H	N	L	W	L	C	N

UPPER PEACE

YEAR	MAY		JUNE		JULY		AUGUST	
	TEMP	PREC	TEMP	PREC	TEMP	PREC	TEMP	PREC
1966	N	L	N	M	C	H	N	M
1967	C	M	W	L	W	L	W	L
1968	N	M	N	H	N	H/M	W	L
1969	N	M	W	L	N	M	W	M
1970	N	M	W	L	C	H	N	M
1971	N	H	W	L	C	H	W	L
1972	C	M	N	H	C	H	N	M
1973	W	M	N	M	N	M	W	M
1974	N	L	N	L	W	L	N	H
1975	N	L	N	H	N	H	W	A
1976	W	L	W	L	N	H	W	L
1977	W	L	N	H	W	L	N	M
1978	W	L	N	H	W	L	N	L
1979	N	L	N	L	N	H	N	A
1980	W	H	N	L	N	H	N	L
1981	N	H	N	H	C	H	W	L
1982	N	H	N	L	W	L	C	M

RAINY LAKE (LAKE OF THE WOODS)

YEAR	MAY		JUNE		JULY		AUGUST	
	TEMP	PREC	TEMP	PREC	TEMP	PREC	TEMP	PREC
1966	C	M	N	M	W	M	W	M
1967	C	M	N	H	VW	L	N	L
1968	N	L	W	M	W	L	W	M/L
1969	C	L	W	L	C	M	C	M
1970	C	M	W	M	N	L	W	L
1971	N	H	N	H	C	M	N	M
1972	N	M	W	M	W	L	N	M
1973	W	L	W	L	W	L	N	M
1974	C	H	N	H	C	H	W	L
1975	C	H	N	H	N	H	W	H
1976	N	M	N	H	W	L	W	L
1977	N	L	N	L	W	L	N	H
1978	N	L	N	L	W	L	N	H
1979	N	H	N	L	W	L	A	H
1980	N	L	W	L	W	H	N	L
1981	C	H	W	M	W	L	N	H
1982	N	H	W	L	W	H	C	H

MADAWASKA

YEAR	MAY		JUNE		JULY		AUGUST	
	TEMP	PREC	TEMP	PREC	TEMP	PREC	TEMP	PREC
1966	N	H	C	H	W	H	N	L
1967	C	H	N	M	W	L	N	L
1968	C	L	W	H	N	M	W	L
1969	N	L	C	M	N	M	C	H
1970	C	L	C	M	W	M	C	M
1971	W	H	N	H	W	M	N	M
1972	C	M	N	M	W	L	N	M
1973	W	M	W	M	W	M	C	M
1974	N	L	W	H	N	L	C	H
1975	W	H	W	H	N	L	N	A
1976	C	H	W	L	W	H	N	H
1977	W	L	N	M	C	H	N	L
1978	W	L	C	H	C	H	W	L
1979	N	H	W	H	N	H	W	H
1980	N	M	W	H	W	L	W	H
1981	W	L	N	H	N	H	N	A
1982	C	H	N	L	W	L	W	L

MERSEY

YEAR	MAY		JUNE		JULY		AUGUST	
	TEMP	PREC	TEMP	PREC	TEMP	PREC	TEMP	PREC
1966	N	M	N	L	C	M	N	L
1967	C	L	C	L	C	M	C	H
1968	W	M	C	M	N	H	W	M
1969	N	M	C	M	C	M	C	M
1970	N	M	C	M	W	M	W	M
1971	W	M	C	M	W	M	N	M
1972	C	M	N	M	W	M	W	M
1973	N	M	N	H	N	H	W	M
1974	N	L	C	H	C	H	N	H
1975	N	M	C	H	C	H	N	H
1976	N	M	N	M	N	H	N	H
1977	N	H	C	H	C	M	N	H
1978	N	H	C	H	N	H	N	H
1979	W	H	N	H	C	H	N	M
1980	N	H	W	H	W	L	N	H
1981	N	H	N	L	W	H	W	L
1982	N	L	W	H	N	L	C	H

APPENDIX 2

Temperature and Precipitation

Conditional means, standard deviations, limit (threshold) values for:

Stikine
Upper Peace
Rainy Lake
Madawaska
Mersey

NOTES

μ - conditional mean

σ - standard deviation

$C_v = \frac{\sigma}{\mu}$ $C_s = 2C_v$

T_c, T_w - temperature threshold value (cold, warm, respectively)

P_L, P_H - precipitation threshold value (low, high, respectively)

ρ_L, ρ_H - probability of occurrence

$\Phi(\rho_L, C_s)$, $\Phi(\rho_H, C_s)$ - gamma distribution value

1) computed from normative normal distribution (see pages 15, 21)

2) computed from NOAA table (see page 21)

3) relative values (differences from climatic normals)

TEMPERATURES: CLIMATIC NORMALS

STIKINE

MONTH	TYPE OF FORECAST	μ		σ		T_c	T_w
5	N	6.1 [1]	[2]	0.9 [1]	0.9016 [2]	5.6290	6.5721
	0.4C	5.8464	5.8498	0.6823	0.8780		
	0.5C	5.6280		0.7367	0.8214		
	0.4W	6.3536	6.3502				
	0.5W	6.5721					
6	N	10.4		1.5	1.5027	9.6133	11.1868
	0.4C	9.9773	9.9830	1.4371	1.4634		
	0.5C	9.6133		1.2278	1.3689		
	0.4W	10.8227	10.8170				
	0.5W	11.1868					
7	N	12.5		1.3	1.3023	11.8182	13.1815
	0.4C	12.1336	12.1386	1.2455	1.2682		
	0.5C	11.8182		1.0641	1.1864		
	0.4W	12.8664	12.8614				
	0.5W	13.1819					
8	N	11.6		1.3	1.3023	10.9182	12.2819
	0.4C	11.2336	11.2386	1.2455	1.2682		
	0.5C	10.9182		1.0641	1.1864		
	0.4W	11.9664	11.9614				
	0.5W	12.2819					

TEMPERATURES: DATA[3])

STIKINE

MONTH	TYPE OF FORECAST	μ		σ		T_c	T_w
5	N	-0.420 [1])	[2])	0.6818 [1])	0.6830 [2])	-0.776	-0.0624
	0.4C	-0.6121	-0.6095	0.6532	0.6651		
	0.5C	-0.776		0.5581	0.6222		
	0.4W	-0.2279	-0.2305				
	0.5W	-0.0624					
6	N	-0.2200		1.5105	1.5132	-1.0123	0.5723
	0.4C	-0.6457	-0.6399	1.4472	1.4736		
	0.5C	-1.0123		1.2364	1.8785		
	0.4W	0.2059	0.1999				
	0.5W	0.5723					1.5053
7	N	-0.2050		1.2284	1.2306	-0.8493	0.4393
	0.4C	-0.5512	-0.5465	1.1769	1.1984		
	0.5C	-0.8493		1.0055	1.1211		
	0.4W	0.1412	0.1365				
	0.5W	0.4393					1.2242
8	N	-0.1300		1.2568	1.2581	-0.7887	0.5287
	0.4C	-0.4839	-.4791	1.2032	1.2251		
	0.5C	-.7887		1.0279	1.1461		
	0.4W	.2239	.2191				
	0.5W	.5287					1.2515

TEMPERATURES: CLIMATIC NORMALS

PEACE

MONTH	TYPE OF FORECAST	μ		σ		T_c	T_w
5	N	9.1 [1]	[2]	1.1 [1]	1.1020[2]	8.5231	9.6770
	0.4C	8.7900	8.7942	1.0539	1.0731		
	0.5C	8.5231		0.9004	1.0039		
	0.4W	9.4100	9.4058				
	0.5W	9.6770					
6	N	13.1		1.0	1.0018	12.5755	13.6345
	0.4C	12.8182	12.8220	0.9581	0.9756		
	0.5C	12.5755		0.8185	0.9126		
	0.4W	13.3818	13.3780				
	0.5W	13.6245					
7	N	15.1		1.0	1.0018	14.5755	15.6245
	0.4C	14.8182	14.8220	0.9581	0.9756		
	0.5C	14.5755		0.8185	0.9126		
	0.4W	15.3818	15.3780				
	0.5W	15.6245					
8	N	13.9		1.2	1.2022	13.2706	14.5294
	0.4C	13.5618	13.5664	1.1497	1.1707		
	0.5C	13.2706		0.9822	1.0952		
	0.4W	14.2382	14.2336				
	0.5W	14.5294					

TEMPERATURES: DATA[3])

PEACE

MONTH	TYPE OF FORECAST	μ		σ		T_c	T_w
5	N	0.2357[1])	[2])	1.1991[1])	1.2013[2])	-0.3932	0.8646
	0.4C	-0.1022	-0.0976	1.1488	1.1698		
	0.5C	-0.3932		0.9815	1.0943		
	0.4W	0.5736	0.5690				
	0.5W	0.8646					
6	N	0.2286		0.9801	0.9819	-0.2855	0.7427
	0.4C	-0.0476	-0.0439	0.9390	0.9562		
	0.5C	-0.2855		0.8022	0.8945		
	0.4W	0.5048	0.5011				
	0.5W	0.7427					
7	N	-0.1571		1.1113	1.1133	-0.7400	0.4258
	0.4C	-0.4703	-0.4660	1.0647	1.0842		
	0.5C	-0.7400		0.9096	1.0142		
	0.4W	0.1561	0.1518				
	0.5W	0.4258					

TEMPERATURES: CLIMATIC NORMALS — LAKE OF THE WOODS (Rainy Lake)

MONTH	TYPE OF FORECAST	μ		σ		T_c	T_w
4	N	2.4 [1]	[2]	2.1 [1]	2.1038 [2]	1.2986	3.5015
	0.4C	1.8082	1.8162	2.0120	2.0487		
	0.5C	1.2986		1.7189	1.9165		
	0.4C	2.9918	2.9838				
	0.5W	3.5015					
5	N	10.1		2.3	2.3041	8.8937	11.3064
	0.4C	9.4518	9.4606	2.2036	2.2438		
	0.5C	8.8937		1.8826	2.0990		
	0.4W	10.7482	10.7394				
	0.4W	11.3064					
6	N	15.7		1.6	1.6029	14.8608	16.5392
	0.4C	15.2491	15.2852	1.5329	1.5609		
	0.4C	14.8608		1.3096	1.4602		
	0.4W	16.1509	16.1448				
	0.5W	16.5392					
7	N	18.7		1.4	1.4025	17.9657	19.4343
	0.4C	18.3055	18.3108	1.3413	1.3658		
	0.5C	17.9657		1.1452	1.2777		
	0.4W	19.0945	19.0892				
	0.5W	19.4345					

TEMPERATURES: DATA[3])

RAINY LAKE (L. of the Woods)

MONTH		μ		σ		T_c	T_w
4	N	-0.4154		2.2463	2.2503	-1.5936	0.7628
	0.4C	-1.0484	-1.0398	2.1521	2.1914		
	0.5C	-1.5936		1.8386	2.0500		
	0.4W	0.2176	0.2030				
	0.5W	0.7628					
5	N	-0.100		2.1159	2.1197	-1.2098	1.0098
	0.4C	-0.6963	-0.6882	2.0272	2.0642		
	0.5C	-1.2098		1.7313	1.9310		
	0.4W	0.4963	0.4882				
	0.5W	1.0098					2.1086
6	N	-0.1985		1.9027	1.9061	-1.1965	0.7995
	0.4C	-0.7397	-0.7274	1.8229	1.8562		
	0.5C	-1.1965		1.5574	1.7365		
	0.4W	1.3377	0.3304				
	0.5W	0.7995					
7	N	0.1123		1.6619	1.6649	-0.7594	0.9840
	0.4C	-0.3561	(-0.3497)	1.5922	1.6213		
	0.5C	-0.9594		1.3603	1.5167		
	0.4W	0.5807	(0.5743)				
	0.5W	0.9840					1.6562

TEMPERATURE: CLIMATIC NORMALS

MADAWASKA

MONTH	TYPE OF FORECAST	μ		σ		T_c	T_w
3	N	-4.7 [1]	[2]	2.7 [1]	2.7048 [2]	-6.1162	-3.2839
	0.4C	-5.4609	-5.4506	2.5868	2.6340		
	0.5C	-6.1162		2.2100	2.4641		
	0.4W	-3.9391	-3.9494				
	0.5W	-3.2839					
4	N	3.7		1.7	1.7031	2.8084	4.5917
	0.4C	3.2209	3.2284	1.6287	1.6585		
	0.5C	2.8084		1.3915	1.5515		
	0.4W	4.1791	4.1726				
	0.5W	4.5917					
5	N	10.5		1.9	1.9034	9.5035	11.4966
	0.4C	9.9645	9.9718	1.8203	1.8536		
	0.5C	9.5035		1.5552	1.7340		
	0.4W	11.0355	11.0282				
	0.5W	11.4966					
6	N	15.4		1.2	1.2022	14.7706	16.0294
	0.4C	15.0618	15.0664	1.1497	1.1707		
	0.5C	14.7706		0.9822	1.0952		
	0.4W	15.7382	15.7336				
	0.5W	16.0294					

TEMPERATURE: DATA[3])

MADAWASKA

MONTH	TYPE OF FORECAST	μ		σ		T_c	T_w
3	N	0.3562[1])	[2])	2.938[1])	2.9433[2])	-1.1848	1.8572
	0.4C	-0.4718	-0.4605	2.8148			
	0.5C	-1.1848		2.4048			
	0.4W	1.1842	1.1729				
	0.5W	1.8572					
4	N	-0.2313		1.8582	1.8615	-1.2059	0.7433
	0.4C	-0.7550	-0.7479	1.7803	1.8128		
	0.5C	-1.2059		1.5210	1.6958		
	0.4W	0.2524	0.2853				
	0.5W	0.7433					
5	N	-0.3125		1.7825	1.7857	-1.2474	0.6224
	0.4C	-0.8148	-0.8080	1.7078	1.7390		
	0.5C	-1.2474		1.4590	1.6268		
	0.4W	0.1898	0.1830				
	0.5W	0.6224					
6	N	0.1375		1.3089	1.3112	-0.5490	0.8240
	0.4C	-0.2314	-0.2264	1.2540	1.2765		
	0.5C	-0.5490	0.5014	1.0713	1.1945		
	0.4W	0.5064					
	0.5W	0.8240					

TEMPERATURE: CLIMATIC NORMALS

MERSEY

MONTH	TYPE OF FORECAST	μ		σ		T_c	T_w
3	N	-0.1 [1]	[2]	1.6 [1]	1.6029 [2]	-0.9392	0.7392
	0.4C	-0.5509	-0.5448	1.5329	1.5605		
	0.5C	-0.9392		1.3096	1.4602		
	0.4W	0.3509	0.3448				
	0.5W	0.7392					
4	N	5.1		1.4	1.4025	4.3657	5.8343
	0.4C	4.7055	4.7108	1.3413	1.3658		
	0.5C	4.3657		1.1459	1.2777		
	0.4W	5.4945	5.4892				
	0.5W	5.8343					
5	N	10.5		1.3	1.3023	9.8182	11.1819
	0.4C	10.1336	10.1386	1.2455	1.2682		
	0.5C	9.8182		1.0641	1.1864		
	0.4W	10.8664	10.8614				
	0.5W	11.1819					
6	N	15.9		1.0	1.0018	15.3755	16.4245
	0.4C	15.6182	15.6220	0.9581	0.9756		
	0.5C	15.3755		0.8185	0.9126		
	0.4W	16.1818	16.1780				
	0.5W	16.4245					
7	N	19.1		1.2	1.2022	18.4706	19.7294
	0.4C	18.7618	18.7664	1.1497	1.1707		
	0.5C	18.4706		0.9822	1.0952		
	0.4W	19.4382	19.4326				
	0.5W	19.7294					

TEMPERATURES: DATA[3])

MERSEY

MONTH	TYPE OF FORECAST	μ		σ		T_c	T_w
3	N	.3538[1])	[2])	1.4937[1])	1.4964[2])	-0.42196	1.1372
	0.4C	-0.0672	-0.0614	1.4311	1.4572		
	0.5C	-0.4296		1.2226	1.3632		
	0.4W	0.7748	0.7630				
	0.5W	1.1372					
4	N	.0923		1.1885	1.1906	-0.5311	0.7157
	0.4C	-0.2426	-0.2381	1.1387	1.1595		
	0.5C	-0.5311		0.9728	1.0847		
	0.4W	0.4272	0.4227				
	0.5W	0.7157	0.7157				
5	N	.3923		1.1485	1.1506	-0.2101	0.9947
	0.4C	0.0686	0.0730	1.1004	1.1204		
	0.5C	-0.2101		0.9401	1.0482		
	0.4W	0.7160	0.7116				
	0.5W	0.9947					
6	N	.2769		1.0068	1.0086	-0.2512	0.8050
	0.4C	-0.0068	-0.0030	0.9646	0.9822		
	0.5C	-0.2512		0.8241	0.9188		
	0.4W	0.5606	0.5568				
	0.5W	0.8050					
7	N	.1538		1.0170	1.0188	-0.3726	0.6872
	0.4C	-0.1328	-0.1289	0.9744	0.9922		
	0.5C	-0.3796		0.8324	0.9281		
	0.4W	0.4404	0.4365				
	0.5W	0.6872					

PRECIPITATIONS: DATA		CONST. σ								STIKINE		
MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\phi(\rho_L, C_s)$	ρ_H	$\phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
5	N	24.8550	10.1505							18.7444	28.9964	10.252
	0.35L	23.6944	10.9874	0.4261	0.8523	.65	-0.4902	.25	0.5748	18.7444	29.4981	
	0.35H	26.2885		0.3841	0.7682	.75	-0.7300	.35	0.2682	18.9174	28.9964	
6	N	44.01	20.0758							31.7438	52.0001	20.256
	0.35L	41.7432	19.9714	0.4784	0.9569	.65	-0.5007	.25	0.5586	31.7438	52.8998	
	0.35H	46.8140		0.4266	0.8532	.75	-0.7300	.35	0.2597	32.2348	52.0001	
7	N	59.63	30.3262							40.8278	71.0327	30.21
	0.35L	56.2803	30.1685	0.5360	1.0721	.65	-0.5122	.25	0.5428	40.8278	72.6556	
	0.35H	63.6305		0.4741	0.9482	.75	-0.7300	.35	0.2354	41.6075	71.0327	
8	N	52.77	22.2892							39.3075	61.8193	22.51
	0.35L	50.2447	22.1723	0.4413	0.8826	.65	-0.4933	.25	0.5717	39.3075	62.9221	
	0.35H	55.9277		0.3965	0.7929	.75	-0.7300	.35	0.2657	39.7412	61.8193	

PRECIPITATIONS: DATA CONSTANT P_L, P_H STIKINE

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\Phi(\rho_L, C_s)$	ρ_H	$\Phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
5	N	24.855	10.1505	0.40839	0.816777	0.7	-0.602	0.3	0.408	18.7444	28.9964	10.252
	0.35L	23.4324	9.62631	0.41081	0.821623	0.65	-0.487	0.25	0.578			
	0.35H	26.23033	10.282868	0.392022	0.78404		-0.728	0.35	0.269			
6	N	44.01	20.0758	0.45616	0.912329	0.7	-0.611	0.3	0.398	31.7438	52.0001	20.256
	0.35L	41.21452	19.05578	0.46236	0.92471	0.65	-0.497		0.566			
	0.35H	46.72566	20.523090	0.439225	0.87845	0.75	-0.73		0.257			
7	N	59.63	30.3262	0.508573	1.0171	0.7	-0.62	0.3	0.376	40.8278	71.0327	30.326
	0.35L	55.45906	28.745213	0.51831	1.0366	0.65	-0.509		0.546			
	0.35H	63.57411	31.29639	0.491509	0.983017	0.75	-0.73		0.239			
8	N	52.77	22.2892	0.42238	0.84477	0.7	-0.604	0.3	0.406	39.30745	61.81933	22.511
	0.35L	49.66503	21.137915	0.425610	0.851219	0.65	-0.490		0.575			
	0.35H	55.84032	22.64777	0.40558	0.81116	0.75	-0.73		0.264			

PRECIPITATIONS: CLIMATIC NORMALS CONST. σ STIKINE

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\Phi(\rho_L, C_s)$	ρ_H	$\Phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
5	N	23.1	10.3	0.4459	0.8918					16.8255	27.2285	10.4050
	0.35L	21.9327	10.2464	0.4672	0.9344	.65	-0.4984	.25	0.5631	16.8255	27.7027	
	0.35H	23.5488		0.4174	0.8348	.75	-0.7300	.35	0.2615	17.0690	27.2285	-
6	N	43.6	19.7	0.4518	0.9037					31.5758	51.4655	19.8898
	0.35L	41.3696	19.5976	0.4737	0.9474	.65	-0.4997	.25	0.5605	31.1758	52.3543	
	0.36H	46.3612		0.4227	0.8454	.75	-0.7300	.35	0.2605	32.0549	51.4655	-
7	N	55.5	28.3	0.5099	1.0198					37.9540	66.1418	28.1878
	0.35L	52.3820	28.1528	0.5375	1.0749	.65	-0.5125	.25	0.5425	37.9540	67.6552	
	0.35H	59.2461		0.4752	0.9504	.75	-0.7300	.35	0.2449	38.6949	66.1418	-
8	N	52.5	20.2	0.3848	0.7695					40.3800	60.9051	20.5251
	0.35L	50.1295	20.0950	0.4009	0.8017	.65	-0.4852	.25	0.5798	40.5800	61.7811	
	0.35N	55.2863		0.3635	0.7269	.75	-0.7227	.35	0.2796	40.7638	60.9051	-

PRECIPITATIONS: CLIMATIC NORMALS CONST. σ PEACE

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\Phi(\rho_L, C_s)$	ρ_H	$\Phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
5	N	35.2	39.9	1.1335	2.2670					9.9315	41.0490	31.1175
	0.35L	32.3578	39.6925	1.2267	2.4534	.65	-0.5650	.25	0.2793	9.9315	43.4451	
	0.35H	38.9645		1.0187	2.0374	.75	-0.7063	.35	0.0525	10.9311	41.0490	-
6	N	72.8	45.0	0.6181	1.2363					44.4500	88.2236	43.7736
	0.35L	68.2306	44.7660	0.6561	1.3122	.65	-0.5312	.25	0.5076	44.4500	90.9523	
	0.35H	78.8383		0.5678	1.1356	.75	-0.7400	.35	0.2097	45.7115	88.2236	-
7	N	70.8	43.6	0.6158	1.2316					43.3320	85.7841	42.4521
	0.35L	66.3518	43.3733	0.6537	1.3074	.65	-0.5307	.25	0.5085	43.3320	88.4082	
	0.35H	76.6634		0.5658	1.1315	.75	-0.7400	.35	0.2103	44.5671	85.7841	-

PRECIPITATIONS: DATA CONST. σ PEACE

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\phi(\rho_L, C_s)$	ρ_H	$\phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
5	N	36.9571	0.3489	0.8212	1.6424	0.7		0.3		17.5338	45.1975	27.6637
	0.35L	34.3752	30.1911	0.8783	1.7566	0.65	-0.5578	0.25	0.4287	17.5338	47.3178	
	0.35H	40.6101	30.1911	0.7434	1.4869	0.75	-0.7300	0.35	0.1520	18.5706	45.1975	-
6	N	78.2143	44.5847	0.5700	1.1401	0.7		0.3		50.3932	94.0862	43.6930
	0.35L	73.6869	44.3529	0.6019	1.2038	0.65	-0.5252	0.25	0.5196	50.3932	96.7335	
	0.35H	84.1443	44.3529	0.5271	1.0542	0.75	-0.7354	0.35	0.2242	51.5262	94.0862	-
7	N	69.0143	43.2493	0.6267	1.2533	0.7		0.3		41.7672	83.6901	41.9229
	0.35L	64.6991	43.0244	0.6650	1.3300	0.65	-0.5330	0.25	0.5040	41.7672	86.3836	
	0.35H	74.7682	43.0244	0.5754	1.1509	0.75	-0.7400	0.35	0.2074	42.9302	83.6001	-

PRECIPITATIONS: CLIMATIC NORMALS CONST. σ LAKE OF THE WOODS (Rainy Lake)

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\Phi(\rho_L, C_s)$	ρ_H	$\Phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
4	N	41.6	21.8	0.5240	1.0481					28.0840	49.6744	21.5904
	0.35L	39.2628	21.6866	0.5523	1.1047	.65	-0.5155	.25	0.5391	28.0840	50.9532	
	4H	44.4707		0.4877	0.9753	.75	-0.73	.35	0.2399	28.6395	49.6744	
5	5N	68.3	34.8	0.5095	1.0190					46.7240	81.3915	34.6675
	5L	64.4624	34.6190	0.5370	1.0741	.65	-0.5124	.25	0.5426	46.7240	83.2463	
5	5H	72.9111		0.4748	0.9496	.75	-0.73	.35	0.2450	47.6392	81.3915	-
6	6N	95.5	30.9	0.3236	0.6471					77.1234	108.9504	31.8270
	6L	91.7406	30.7353	0.3351	0.6701	.65	-0.4755	.25	0.5960	77.1234	110.0604	
	6N	99.8025		0.3080	0.6160	.75	-0.7200	.35	0.2976	77.6702	108.9504	-
7	7N	98.9	33.3	0.3367	0.6734					79.0086	113.3076	34.2990
	7L	94.9002	33.1268	0.3491	0.6981	.65	-0.4797	.25	0.5904	79.0086	114.4574	
	7H	103.5669		0.3199	0.6397	.75	-0.7200	.35	0.2940	79.7156	113.3076	-

PRECIPITATIONS: DATA CONSTANT P_L, P_H LAKE OF THE WOODS (Rainy Lake)

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\phi(\rho_L, C_s)$	ρ_H	$\phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
5	N	60.0908	32.9310	0.54802	1.0960	.70	-0.62	0.30	0.36	39.6736	71.9720	32.29
	0.35H	64.3709	33.6258	0.5224	1.0448	.75	-0.7345	.35	0.2260			
	0.35L	55.4606	30.6277	0.5522	1.1045	.65	-0.5154	.25	0.5391			
6	N	85.4736	37.0385	0.43333	0.86667	.70	-0.606	.30	0.403	63.0036	100.4125	37.40
	0.35L	80.3024	35.1257	0.4374	0.8748	.65	-0.4925	.25	0.5725			
	0.35H	91.00919	38.32965	0.42116	0.84233	.75	-0.73	.35	0.245			
		90.55743	37.71100	0.41643	0.83286		-0.73		0.261			
		90.52528	37.67298	0.41616	0.83232		-0.73		0.2617			
		90.5414	37.7230	0.4166	0.8333		-0.73		0.2617			
7	N	94.5492	32.0255	0.3387	0.6774	.7	-0.598	.3	0.432	75.4062	108.3924	32.98
	0.35L	90.1170	30.8048	0.3418	0.6837	.65	-0.4775	.25	0.5933			
	0.35H	98.959	32.72470	0.330688	0.661375	.75	-0.72	.35	0.288			
		98.8972	32.6265	0.3299	0.6598		-0.72		0.2910			

4) April values not calculated

PRECIPITATIONS: DATA CONST. σ — LAKE OF THE WOODS (Rainy Lake)

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\Phi(\rho_L, C_s)$	ρ_H	$\Phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
4	N	40.4062	32.1579							19.8251	49.4636	
	0.35L	37.5837	31.9907	0.8512	1.7024	.65	-0.5551	.25	0.4395	19.8251	51.6445	
	0.35H	44.3848		0.7208	1.4415	.75	-0.730	.35	0.1588	21.0316	49.4636	
5	N	60.0908	32.9310							39.6736	71.9720	
	0.35L	56.7252	32.7598	0.5775	1.1550	.65	-0.5205	.25	0.5145	39.6736	73.5799	32.29
	0.35H	64.3880		0.5088	1.0176	.75	-0.7318	.35	0.2315	40.4158	71.9720	
6	N	85.4736	37.0385							63.0036	100.4125	
	0.35L	81.4616	37.1906	0.4565	0.9131	.65	-0.4963	.25	0.5674	63.0036	102.5629	37.40
	0.35H	90.6339		0.4103	0.8207	.75	-0.73	.35	0.2629	63.4848	100.4125	
7	N	94.5492	32.0255							75.4062	108.3924	
	0.35L	90.7025	31.8590	0.3512	0.7025	.65	-0.4801	.25	0.5898	75.4062	109.4913	32.98
	0.35H	99.0418		0.3217	0.6433	.75	-0.72	.35	0.2935	76.1034	108.3924	

PRECIPITATION: CLIMATIC NORMALS CONST. σ MASAWASKA

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\Phi(\rho_L, C_s)$	ρ_H	$\Phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
3	N	49.4	23.4	0.4737	0.9474	.7		.3		35.0152	58.5383	23.5232
	0.35L	46.7606	23.2783	0.4978	0.9956	.65	-0.5046	.25	0.5509	35.0152	59.5840	
	0.35H	52.5689	23.2783	0.4428	0.8856	.75	-0.7300	.35	0.2564	35.5757	58.5383	
4	N	58.0	23.4	0.4034	0.8069	.7		.3		43.9439	67.5779	23.6340
	0.35L	55.3303	23.2783	0.4207	0.8414	.65	-0.4891	.25	0.5750	43.9439	68.7353	
	0.35H	61.2249	23.2783	0.3802	0.7604	.75	-0.7260	.35	0.2729	44.3238	67.5779	
5	N	62.2	27.4	0.4405	0.8810	.7		.3		45.5380	73.2120	27.6740
	0.35L	59.0919	27.2575	0.4613	0.9225	.65	-0.4973	.25	0.5655	45.5380	74.5058	
	0.35H	66.0576	27.2575	0.4126	0.8253	.75	-0.7300	.35	0.2625	46.1586	73.2120	-
6	N	84.9	46.2	0.5442	1.0883	.7		.3		56.2560	101.6397	45.3837
	0.35L	80.1411	45.9598	0.5735	1.1470	.65	-0.5197	.25	0.5306	56.2560	104.5297	
	0.35H	90.9384	45.9598	0.5054	1.0108	.75	-0.7311	.35	0.2328	57.3382	101.6397	

PRECIPITATIONS: DATA CONST. σ MADAWASKA

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\Phi(\rho_L, C_s)$	ρ_H	$\Phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
3	N	49.9500	22.7322	0.4551	0.9102					36.0602	58.9965	22.9363
	0.35L	47.3777	22.6140	0.4773	0.9546	.65	-0.5005	0.25	0.5591	36.0602	60.0206	
	0.35H	53.1201	22.6140	0.4257	0.8514	.75	-0.7300	0.35	0.2599	36.6119	58.9965	
4	N	57.8500	30.0348	0.5192	1.0384					39.2284	69.0327	29.8043
	0.35L	54.5994	29.8786	0.5472	1.0945	.65	-0.5144	0.25	0.5406	39.2284	70.7503	
	0.35H	61.8126	29.8786	0.4834	0.9667	.75	-0.7367	0.35	0.2417	39.8017	69.0327	
5	N	63.0875	29.4882	0.4674	0.5348					44.0970	74.6773	29.6804
	0.35L	59.7577	29.3345	0.4909	0.9818	.65	-0.5032	.25	0.5536	44.9970	75.9987	
	0.35H	67.1209	29.3349	0.4370	0.8741	.75	-0.7300	.35	0.2576	45.7065	74.6973	
6	N	103.8750	49.1446	0.4731	0.9462					73.6696	123.0785	49.4085
	0.35L	98.3311	48.8890	0.4972	0.9944	.65	-0.5044	.25	0.5511	73.6696	125.2750	
	0.35H	110.5364	48.8890	0.4423	0.8846	.75	-0.7300	.35	0.2565	74.8474	123.0785	

PRECIPITATION: CLIMATIC NORMALS CONST. σ MERSEY

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\Phi(\rho_L, C_s)$	ρ_H	$\Phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
3	N	122.3	51.8	0.4235	0.8471					90.9760	143.2940	52.3180
	0.35L	116.4082	51.5306	0.4427	0.8853	.65	-0.4935	0.25	0.5715	90.9760	145.8561	
	0.35H	129.5898		0.3976	0.7953	0.75	-0.7295	0.35	0.2659	91.9967	143.2940	
4	N	109.3	40.2	0.3678	0.7356					85.1800	126.2999	41.1199
	0.35L	104.5063	39.9910	0.3827	0.3827	0.7653	.65	-0.4833	.25	0.5835	85.1800	127.8397
	0.35H	114.8798		0.3481	0.6962	.75	-0.72	.35	0.2856	86.0863	126.2999	
5	N	96.0	37.1	0.3865	0.7729					73.7400	111.4120	37.6720
	0.35L	91.6595	36.9071	0.4027	0.8053	.65	-0.4855	.25	0.5795	73.7400	113.0460	
	0.35H	101.1149		0.3650	0.7300	.75	-0.7230	.35	0.2790	74.4311	111.4120	-
6	N	75.2	45.9	0.6104	1.2207					46.2830	91.0746	44.7016
	0.35L	70.4740	45.6613	0.6479	1.2958	.65	-0.5298	.25	0.5104	46.2830	91.0746	44.7016
	0.35H	81.4062		0.5609	1.1218	.25	-0.7400	.35	0.02117	47.6174	91.0746	
7	N	80.3	45.2	0.5629	1.1258					52.1595	96.4555	44.2960
	0.35L	75.7112	44.9650	0.5999	1.1878	.65	0.9238	.25	0.5224	52.1595	99.2027	
	0.35H	86.2703	44.9650	0.5212	1.0424	0.75	-0.7342	.35	0.2265	53.2552	96.4555	

PRECIPITATIONS: DATA CONSTANT P_L, P_H MERSEY

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\Phi(\rho_L, C_s)$	ρ_H	$\Phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
3	N	140.7769	40.8856							116.7327	158.9231	
	0.35L	135.6444	40.6730	0.2999	0.5997	.65	-0.4650	.25	0.6100	116.7327	160.4562	0.5723
	0.35H	146.4494		0.2777	0.5555	.75	-0.7155	.35	0.3067	117.3461	158.9231	-0.7306
4	N	124.3462	36.4681							102.8790	140.4902	
	0.35L	119.7807	36.2785	0.3029	0.6057	.65	-0.4659	.25	0.6089	102.8790	141.8689	0.5708
	0.35H	129.3931		0.2804	0.5607	.75	-0.7161	.35	0.3059	103.4150	140.4902	-0.7308
5	N	100.8231	36.4987							78.9239	116.3422	
	0.35L	96.4482	36.3089	0.3765	0.7529	.65	-0.4826	.25	0.5847	78.9239	117.6784	0.5479
	0.35H	105.9158		0.3428	.6856	.75	-0.7200	.35	0.2872	79.7724	116.3422	-0.7434
6	N	93.3231	42.2778							66.4666	109.1001	
	0.35L	87.5413	42.0580	0.4804	0.9609	.65	-0.5011	.25	0.5578	66.4666	111.0023	0.5126
	0.35H	98.1929		0.4283	0.8566	.75	-0.7300	.35	0.2593	67.4906	109.1001	-0.7543
7	N	91.5	44.8214	0.4899	0.9797	0.7		0.3		63.8017	108.7141	

PRECIPITATIONS: DATA CONST. σ — MERSEY

MONTH	TYPE OF FORECAST	μ	σ	C_v	C_s	ρ_L	$\phi(\rho_L, C_s)$	ρ_H	$\phi(\rho_H, C_s)$	P_L	P_H	$P_H - P_L$
3	N	140.7769	40.8856	0.2904	0.5809	0.7		0.3		116.7327	158.9257	42.1904
	0.35L	134.9111	39.2469	0.2909	0.5818	0.65	-0.4632	0.25	0.6118			
	0.35H	146.3153	41.2911	0.2822	0.5644	0.75	-0.7164	0.35	0.3053			
4	N	124.3462	36.4681	0.2933	0.5866	0.7		0.3		102.8790	140.4902	37.6112
	0.35L	119.1043	34.9871	0.2938	0.5875	0.65	-0.4638	0.25	0.6112			
	0.35H	129.2767	35.8188	0.2848	0.5696	0.75	-0.7170	0.35	0.3046			
5	N	100.8231	36.4987	0.3620	0.7240	0.7		0.3		78.9239	116.3422	37.4184
	0.35L	95.7889	35.0215	0.3656	0.7312	0.65	-0.4816	0.25	0.5869			
	0.35H	105.7592	37.2485	0.3522	0.7044	0.75	-0.7204	0.35	0.2841			
6	N	92.3231	42.2778	0.4579	0.9159	0.7		0.3		66.4666	109.1001	42.6335
	6L	86.4503	40.1353	0.4643	0.9286	0.65	-0.4979	0.25	0.5643			
	6H	98.0042	43.2022	0.4408	0.8816	0.75	-0.7300	0.35	0.2568			
7	N	91.5	44.8214	0.4899	0.9797					63.8017	108.7141	44.9124
	0.35L	86.4590	44.5883	0.5157	1.0314	0.65	-0.5081	.25	0.5469	63.8017	110.8424	
	0.35H	97.4765	44.5883	0.4574	0.9149	0.75	-0.7300	.35	0.2520	64.9271	108.7141	

APPENDIX 3

CONDITIONAL MEANS:

Stikine
Upper Peace
Rainy Lake
Madawaska
Mersey

NOTE:

Stikine Q5, Stikine Q6...~ basin, forecasted variable
T3, T4...~ conditional means for temperature
P3, P4...~ conditional means for precipitation

STIKINE Q5

Conditional Means for Climatic Normals

		T5		P5
1	N*	0.0	M	0.0
2	C	-0.25	L	-1.171
3	W	+0.25	H	1.451
4	VC	-0.47		
5	VW	0.47		

Conditional Means for Data

1	N	-0.42	M	1.75
2	C	-0.61	L	0.59
3	W	-0.23	H	3.19
4	VC	-0.78		
5	VW	-0.06		

* See Appendix 1, Table Types of Forecast

STIKINE Q6

Conditional Means for Climatic Normals

		T6		P6
1	N	0.0	M	0.0
2	C	-0.42	L	-2.23
3	W	0.42	H	+2.76

Conditional Means for Data

		T6		P6
1	N	-0.22	M	0.41
2	C	-0.64	L	-1.86
3	W	0.20	H	3.21

STIKINE Q7

Conditional Means for Climatic Normals

		T7		P7
1	N	0.0	M	0.0
2	C	-0.36	L	-3.12
3	W	0.36	H	3.75

Conditional Means for Data

		T7		P7
1	N	-0.205	M	4.13
2	B	-0.55	L	0.78
3	W	0.14	H	8.13

STIKINE Q8

Conditional Means for Climatic Normals

		T8		P8
1	N	0.0	M	0.0
2	C	-0.36	L	-2.37
3	W	0.36	H	2.79

Conditional Means for Data

		T8		P8
1	N	-0.13	M	0.27
2	C	-0.48	L	-2.26
3	W	0.22	H	3.43

PEACE Q5

Conditional Means for Climatic Normals

		T5		P5
1	N	0.0	M	0.0
2	C	-0.31	L	-2.84
3	W	0.31	H	3.76

Conditional Means for Data

		T5		P5
1	N	-0.24	M	1.76
2	C	-0.01	L	-0.82
3	W	0.57	H	5.41

PEACE Q6

Conditional Means for Climatic Normals

		T6		P6
1	N	0.0	M	0.0
2	C	-0.28	L	-4.57
3	W	0.28	H	6.04

Conditional Means for Data

		T6		P6
1	N	0.23	M	5.41
2	C	-0.04	L	0.88
3	W	0.50	H	11.34

PEACE Q7

Conditional Means for Climatic Normals

		T7		P7
1	N	0.0	M	0.0
2	C	-0.28	L	-4.45
3	W	0.28	H	5.86

Conditional Means for Data

		T7		P7
1	N	0.16	M	-1.79
2	C	-0.05	L	-6.10
3	W	0.15	H	3.97

LAKE OF THE WOODS (RAINY LAKE) Q4

Conditional Means for Climatic Normals

		T4		P4
1	N	0.0	M	0.0
2	C	-0.58	L	-2.34
3	W	0.58	H	2.87

Conditional Means for Data

		T4		P4
1	N	-0.415	M	-1.19
2	C	-1.04	L	-4.02
3	W	0.20	H	2.78

LAKE OF THE WOODS (RAINY LAKE) Q5

Conditional Means for Climatic Normals

		T5		P5
1	N	0.0	M	0.0
2	C	-0.64	L	-3.84
3	W	0.64	H	4.61

Conditional Means for Data

		T5		P5
1	N	-0.1	M	-8.21
2	C	-0.69	L	-11.58
3	W	0.49	H	-3.91

LAKE OF THE WOODS (RAINY LAKE) Q6

Conditional Means for Climatic Normals

		T6		P6
1	N	0.0	M	0.0
2	C	-0.44	L	-3.76
3	W	0.44	H	4.30
5	VW	0.84		

Conditional Means for Data

		T6		P6
1	N	-0.20	M	-10.03
2	C	-0.73	L	-14.04
3	W	0.33	H	-4.87
5	VW	0.80		

LAKE OF THE WOODS (RAINY LAKE) Q7

Conditional Means for Climatic Normals

		T7		P7
1	N	0.0	N	0.0
2	C	-0.39	L	-4.0
3	W	0.39	H	4.67

Conditional Means for Data

		T7		P7
1	N	-0.11	N	-4.35
2	C	-0.35	L	-8.20
3	W	0.57	H	0.14

MADAWASKA Q3

Conditional Means for Climatic Normals

		T3		P3
1	N	0.0	M	0.0
2	C	-0.76	L	-2.64
3	W	0.76	H	3.17

Conditional Means for Data

		T3		P3
1	N	0.36	M	0.55
2	C	-0.47	L	2.02
3	W	1.18	H	3.72

MADAWASKA Q4

Conditional Means for Climatic Normals

		T4		P4
1	N	0.0	M	0.0
2	C	-0.48	L	-2.67
3	W	0.48	H	3.22

Conditional Means for Data

		T4		P4
1	N	-0.23	M	0.15
2	C	-0.75	L	-3.40
3	W	0.25	H	3.81

MADAWASKA Q5

Conditional Means for Climatic Normals

		T5		P5
1	N	0.0	M	0.0
2	C	-0.53	L	-3.11
3	W	0.53	H	3.86

Conditional Means for Data

		T5		P5
1	N	-0.32	M	0.89
2	C	-0.81	L	-2.44
3	W	0.19	H	4.92

MADAWASKA Q6

Conditional Means for Climatic Normals

		T6		P6
1	N	0.0	M	0.0
2	C	-0.34	L	-4.76
3	W	0.34	H	6.04

Conditional Means for Data

		T6		P6
1	N	0.14	M	19.13
2	C	-0.23	L	13.43
3	W	0.51	H	25.64

MERSEY Q4

Conditional Means for Climatic Normals

		T4		P4
1	N	0.0	M	0.0
2	C	-0.39	L	-4.79
3	W	0.39	H	5.58

Conditional Means for Data

		T4		P4
1	N	0.09	M	15.05
2	C	-0.24	L	10.48
3	W	0.42	H	20.09

MERSEY Q5

Conditional Means for Climatic Normals

		T5		P5
1	N	0.0	M	0.0
2	C	-0.36	L	-4.34
3	W	0.36	H	5.11

Conditional Means for Data

		T5		P5
1	N	0.39	M	4.82
2	C	-0.07	L	0.45
3	W	0.71	H	9.92

MERSEY Q6

Conditional Means for Climatic Normals

		T6		P6
1	N	0.0	M	0.0
2	C	-0.28	L	-4.73
3	W	0.28	H	6.20

Conditional Means for Data

		T6		P6
1	N	0.28	M	17.12
2	C	-0.003	L	12.34
3	W	0.56	H	22.99

MERSEY Q7

Conditional Means for Climatic Normals

		T7		P7
1	N	0.0	M	0.0
2	C	-0.33	L	-4.59
3	W	0.33	H	5.97

Conditional Means for Data

		T7		P7
1	N	0.15	M	11.2
2	C	-0.13	L	6.26
3	W	0.44	H	17.18

APPENDIX 4

STREAMFLOW VOLUME FORECASTING

FINAL MULTIVARIATE REGRESSION EQUATIONS

NOTE:

r-COEFFICIENT, F-TEST STATISTIC EVALUATION: * significant at 95%
** significant at 99%

THE STRUCTURE OF PREDICTION EQUATIONS

STIKINE

DEPENDENT VARIABLE	FORECAST TYPE	INDEPENDENT VARIABLES INCLUDED IN EQUATION (X)																						F-Test	r
		T3	T4	T5	T6	T7	T8	PS2	PS3	PS4	P2	P3	P4	P5	P6	P7	P8	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8		
Q5	A	X	X							X																1.510	.4697*
Q5	B	X	X	X						X				X												3.739	.7562**
Q6	A	X	X	X						X				X								X				.771	.5122*
Q6.	B	X	X	X	X					X				X	X							X				1.884	.7604**
Q7	A		X	X	X					X				X	X							X	X			6.052**	.9027**
Q7	B		X	X	X	X				X				X	X	X						X	X			5.585**	.9280**
Q8	A			X	X	X				X				X	X	X							X	X		2.983	.8536**
Q8	B			X	X	X	X			X				X	X	X	X						X	X		3.416*	.9080**

THE STRUCTURE OF PREDICTION EQUATIONS

UPPER PEACE

DEPENDENT VARIABLE	FORECAST TYPE	INDEPENDENT VARIABLES INCLUDED IN EQUATION (X)													F-Test	r
		T3	T4	T5	T6	T7	PS4	P5	P6	P7	Q4	Q5	Q6	Q7	Q8		
Q5	A		X				X				X					.921	.4652
Q5	B		X	X			X	X			X					2.926	.8040**
Q6	A		X	X			X	X			X	X				2.255	.8118**
Q6	B		X	X	X		X	X	X		X	X				1.234	.8147**
Q7	A		X	X	X		X	X	X			X	X			1.989	.8723**
Q7	B		X	X	X	X	X	X	X	X		X	X			1.745	.9237**

THE STRUCTURE OF PREDICTION EQUATIONS

RAINY LAKE

DEPENDENT VARIABLE	FORECAST TYPE	INDEPENDENT VARIABLES INCLUDED IN EQUATION (X)																					F-Test	12
		T3	T4	T5	T6	T7	T8	PS2	PS3	PS4	P2	P3	P4	P5	P6	P7	P8	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8		
Q4	A	X							X											X						16.491*	.6692**
Q4	B	X	X						X				X							X						10.766**	.6907**
Q5	A	X	X							X										X	X					11.308**	.6995**
Q5	B	X	X	X						X				X						X	X					9.311**	.7304**
Q6	A	X	X	X						X				X						X	X	X				12.429**	.7998**
Q6	B	X	X	X	X					X				X	X					X	X	X				9.964**	.8053**
Q7	A	X	X	X	X					X				X	X					X	X	X	X			16.228**	.8781**
Q7	B	X	X	X	X	X				X				X	X	X				X	X	X	X			14.066**	.8843**

THE STRUCTURE OF PREDICTION EQUATIONS

MADAWASKA

DEPENDENT VARIABLE	FORECAST TYPE	INDEPENDENT VARIABLES INCLUDED IN EQUATION (X)																					F-Test	12
		T3	T4	T5	T6	T7	T2	PS2	PS3	PS4	P2	P3	P4	P5	P6	P7	P8	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8		
Q3	A	X													X							2.947				1.522	0.515*
Q3	B	X						X				X							X							4.770*	0.8394**
Q4	A	X		X				X				X							X	X						1.566	0.7147**
Q4	B	X		X	X			X				X	X						X	X						2.420	0.8570**
Q5	A		X	X				X				X	X							X	X					2.352	0.8203**
Q5	B		X	X	X			X				X	X	X						X	X					4.825*	0.9373**
Q6	A			X	X			X				X	X	X							X	X				3.198	0.8861**
Q6	B			X	X	X		X				X	X	X	X						X	X				2.541	0.9141**

THE STRUCTURE OF PREDICTION EQUATIONS

MERSEY

DEPENDENT VARIABLE	FORECAST TYPE	INDEPENDENT VARIABLES INCLUDED IN EQUATION (X)																						F-Test	12
		T3	T4	T5	T6	T7	T8	PS2	PS3	PS4	P2	P3	P4	P5	P6	P7	P8	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8		
Q4	A	X										X														0.088	0.136
Q4	B	X	X									X	X													0.083	0.1926
Q5	A	X	X							X											X					1.324	0.6311*
Q5	B	X	X	X						X				X							X					1.282	0.7495*
Q6	A		X	X								X	X	X							X	X				0.727	0.7103
Q6	B		X	X	X							X	X	X	X						X	X				1.613	0.9104*
Q7	A			X	X							X	X	X	X							X	X			1.843	0.8869**
Q7	B			X	X	X						X	X	X	X	X						X	X			0.900	.9046*

APPENDIX 5

SIX TYPES OF THE FORECAST
EXAMPLE OF CALCULATION
UPPER PEACE - MAY

NO FORECAST

ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN 2 VARIABLES. INITIAL CM ALLOWS FOR 1942 CASES
MAXIMUM CM ALLOWS FOR 16513 CASES

YEAR CASE-NO	DEPENDENT VARIABLE 05	INDEPENDENT VARIABLES 14	PS4
1	-41.	1.	-25.
2	16.	1.	-36.
3	-56.	1.	-43.
4	-40.	2.	-9.
5	43.	-2.	42.
6	-43.	1.	-26.
7	80.	-0.	22.
8	-25.	-1.	-34.
9	-47.	3.	-50.
10	44.	4.	-81.
11	-3.	1.	-78.
12	10.	-3.	-20.
13	-20.	4.	28.
14	77.	-2.	-50.

NOTE:
DEPENDENT VARIABLE IS IN 0.1mm

PERFECT FORECAST

```
SPSS/ONLINE AUTO-MODE
? 20.05 A=1.671+1.655*D4+.053*PS4+6.532*T5-3.137*T4+.122*B5
? 35.05 CASES=14/VARIABLES=D5,T5,P5
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1941 CASES
                     MAXIMUM CM ALLOWS FOR 16511 CASES
```

CASE-NO	D5	T5	P5
1	-96.	-1.	-8.
2	-2.	1.	-17.
3	-117.	-1.	-19.
4	20.	2.	-34.
5	91.	1.	-39.
6	18.	2.	-21.
7	-38.	-2.	8.
8	-21.	-1.	14.
9	-7.	1.	31.
10	37.	1.	82.
11	-66.	-1.	6.
12	-31.	-2.	6.
13	-1.	1.	8.
14	207.	2.	8.

ACTUAL FORECAST BASED ON NORMALS

COMBINATION: 11

```
E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                     MAXIMUM CM ALLOWS FOR 16510 CASES
```

CASE-NO	05	T5	P5
1	-40.	0	0
2	-21.	0	0
3	-62.	0	0
4	-50.	0	0
5	100.	0	0
6	-55.	0	0
7	63.	0	0
8	8.	0	0
9	-104.	0	0
10	-97.	0	0
11	-40.	0	0
12	66.	0	0
13	-82.	0	0
14	60.	0	0

NOTE:
COMBINATION 11 = NORMALS USED AS FORECAST

COMBINATION: 12

```
? 19.05 P5=-2.84
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN    2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                      MAXIMUM CM ALLOWS FOR 16510 CASES
```

CASE-NO	05	T5	P5
1	-44.	0	-3.
2	-24.	0	-3.
3	-65.	0	-3.
4	-53.	0	-3.
5	96.	0	-3.
6	-58.	0	-3.
7	60.	0	-3.
8	5.	0	-3.
9	-107.	0	-3.
10	-100.	0	-3.
11	-44.	0	-3.
12	63.	0	-3.
13	-85.	0	-3.
14	57.	0	-3.

COMBINATION: 13

```
SPSS/ONLINE AUTO-MODE
? 19.05 P5=3.764     .
E
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                     MAXIMUM CM ALLOWS FOR 16510 CASES


   CASE-NO         Q5          T5          P5

         1       -36.           0          4.
         2       -16.           0          4.
         3       -57.           0          4.
         4       -45.           0          4.
         5       104.           0          4.
         6       -50.           0          4.
         7        68.           0          4.
         8        13.           0          4.
         9       -99.           0          4.
        10       -92.           0          4.
        11       -36.           0          4.
                  71.           0          4.
                 -77.           0          4.
                                0          4.
```

COMBINATION: 21

```
SPSS/ONLINE AUTO-MODE
? 18.05 T5=-.306
? 19.05 P5=0
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                     MAXIMUM CM ALLOWS FOR 16510 CASES


   CASE-NO          D5          T5          P5

         1         -60.         -.           0
         2         -41.         -.           0
         3         -82.         -.           0
         4         -70.         -.           0
         5          80.         -.           0
         6         -75.         -.           0
         7          43.         -.           0
         8         -12.         -.           0
         9        -124.         -.           0
        10        -117.         -.           0
        11         -60.         -.           0
        12          46.         -.           0
        13        -102.         -.           0
        14          40.         -.           0
```

COMBINATION: 31

```
SPSS/ONLINE AUTO-MODE
? 18.05 T5=.306
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                     MAXIMUM CM ALLOWS FOR 16510 CASES


   CASE-NO        05         T5         P5

         1       -20.          .          0
         2        -1.          .          0
         3       -42.          .          0
         4       -30.          .          0
         5       120.          .          0
         6       -35.          .          0
         7        83.          .          0
         8        28.          .          0
         9       -84.          .          0
        10       -77.          .          0
        11       -20.          .          0
        12        86.          .          0
        13       -62.          .          0
        14        80.          .          0
```

COMBINATION: 32

```
SPSS/ONLINE AUTO-MODE
? 19.05 P5=-2.84
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                     MAXIMUM CM ALLOWS FOR 16510 CASES


   CASE-NO          05          I5          P5

         1        -24.           .          -3.
         2         -4.           .          -3.
         3        -45.           .          -3.
         4        -33.           .          -3.
         5        116.           .          -3.
         6        -38.           .          -3.
         7         80.           .          -3.
         8         25.           .          -3.
         9        -87.           .          -3.
        10        -80.           .          -3.
        11        -24.           .          -3.
        12         83.           .          -3.
        13        -65.           .          -3.
        14         77.           .          -3.
```

COMBINATION: 33

```
SPSS/ONLINE AUTO-MODE
? 19.85=P5=3.764
? E]
BAD COMMAND NAME.
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                     MAXIMUM CM ALLOWS FOR 16510 CASES


  CASE-NO        05         T5         P5

        1       -16.          .         4.
        2         4.          .         4.
        3       -37.          .         4.
        4       -25.          .         4.
        5       124.          .         4.
        6       -30.          .         4.
        7        88.          .         4.
        8        33.          .         4.
        9       -79.          .         4.
       10       -72.          .         4.
       11       -16.          .         4.
       12        91.          .         4.
       13       -57.          .         4.
       14        85.          .         4.
```

ACTUAL FORECAST BASED ON MEANS

COMBINATION: 11

```
18.05 T5=.2357
? 19.05 P5=1.757
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                     MAXIMUM CM ALLOWS FOR 16510 CASES


  CASE-NO        Q5         T5         P5

        1       -23.          .         2.
        2        -3.          .         2.
        3       -44.          .         2.
        4       -32.          .         2.
        5       117.          .         2.
        6       -37.          .         2.
        7        81.          .         2.
        8        26.          .         2.
        9       -86.          .         2.
       10       -79.          .         2.
       11       -23.          .         2.
       12        84.          .         2.
       13       -64.          .         2.
       14        78.          .         2.
```

NOTE:
COMBINATION 11 = MEANS USED AS FORECAST

COMBINATION: 12

```
SPSS/ONLINE AUTO-MODE
? 19.05 P5=-.825
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                     MAXIMUM CM ALLOWS FOR 16510 CASES


   CASE-NO        05         T5         P5

         1       -26.          .         -1.
         2        -6.          .         -1.
         3       -48.          .         -1.
         4       -36.          .         -1.
         5       114.          .         -1.
         6       -40.          .         -1.
         7        78.          .         -1.
         8        22.          .         -1.
         9       -90.          .         -1.
        10       -82.          .         -1.
        11       -26.          .         -1.
        12        80.          .         -1.
        13       -68.          .         -1.
        14        75.          .         -1.
```

COMBINATION: 13

```
SPSS/ONLINE AUTO-MODE
? 19.05 P5=5.41
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                     MAXIMUM CM ALLOWS FOR 16510 CASES


   CASE-NO          U5          T5          P5

         1        -18.           .          5.
         2          1.           .          5.
         3        -40.           .          5.
         4        -28.           .          5.
         5        122.           .          5.
         6        -33.           .          5.
         7         85.           .          5.
         8         30.           .          5.
         9        -82.           .          5.
        10        -75.           .          5.
        11        -18.           .          5.
        12         88.           .          5.
        13        -60.           .          5.
        14         82.           .          5.
```

COMBINATION: 21

GIVEN 2 VARIABLES: INITIAL CM ALLOWS FOR 1939 CASES
MAXIMUM CM ALLOWS FOR 16510 CASES

CASE-NO	05	T5	P5
1	-44.	-0.	2.
2	-25.	-0.	2.
3	-66.	-0.	2.
4	-54.	-0.	2.
5	95.	-0.	2.
6	-59.	-0.	2.
7	59.	-0.	2.
8	4.	-0.	2.
9	-108.	-0.	2.
10	-101.	-0.	2.
11	-44.	-0.	2.
12	62.	-0.	2.
13	-86.	-0.	2.
14	56.	-0.	2.

COMBINATION: 31

```
:PSS/ONLINE AUTO-MODE
? 20.05 T5=.569
: E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES.  INITIAL CM ALLOWS FOR  1939 CASES
                      MAXIMUM CM ALLOWS FOR 16510 CASES


   CASE-NO         05         15         P5

         1         -1.         1.         2.
         2         19.         1.         2.
         3        -23.         1.         2.
         4        -11.         1.         2.
         5        139.         1.         2.
         6        -15.         1.         2.
         7        102.         1.         2.
         8         47.         1.         2.
         9        -65.         1.         2.
        10        -57.         1.         2.
        11         -1.         1.         2.
        12        105.         1.         2.
        13        -43.         1.         2.
        14        100.         1.         2.
```

COMBINATION: 32

```
SPSS/ONLINE AUTO-MODE
? 25.05 P5=-.825
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                     MAXIMUM CM ALLOWS FOR 16510 CASES
```

CASE-NO	05	15	P5
1	-4.	1.	-1.
2	16.	1.	-1.
3	-26.	1.	-1.
4	-14.	1.	-1.
5	136.	1.	-1.
6	-18.	1.	-1.
7	99.	1.	-1.
8	44.	1.	-1.
9	-68.	1.	-1.
10	-60.	1.	-1.
11	-4.	1.	-1.
12	102.	1.	-1.
13	-46.	1.	-1.
14	97.	1.	-1.

COMBINATION: 33

```
SPSS/ONLINE AUTO-MODE
? @5.05 P5=5.41
? E
ENTERING SPSS.
- - - SCATTERGRAM - - -

GIVEN   2 VARIABLES. INITIAL CM ALLOWS FOR  1939 CASES
                     MAXIMUM CM ALLOWS FOR 16510 CASES


  CASE-NO        05         15         P5

        1        4.          1.         5.
        2       23.          1.         5.
        3      -18.          1.         5.
        4       -6.          1.         5.
        5      143.          1.         5.
        6      -11.          1.         5.
        7      107.          1.         5.
        8       52.          1.         5.
        9      -60.          1.         5.
       10      -53.          1.         5.
       11        4.          1.         5.
       12      110.          1.         5.
       13      -38.          1.         5.
       14      104.          1.         5.
```

APPENDIX 6

SIX TYPES OF THE FORECAST-RESULTS

RESULTS FOR: STIKINE
UPPPER PEACE
RAINY LAKE
MADAWASKA
MERSEY

NOTE:

Q - values are deviations from the mean in mm/month.

P,T - values are either deviations from the climatic normals (for forecasts based on climatic normals) or deviations from the means (for forecasts based on means). P-values are in mm/month, T-values are in °C.

( ) - data estimates included

RIVER BASIN: Stikine

MONTH: May

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	-9.9	4.7	12.6	17.0	13.4	16.3	12.9	N	0.0	-0.42	0.35L	-1.167	0.59	12	1
7	1.6	-2.6	-7.9	6.5	2.9	3.8	1.1	0.4C	-0.25	-0.609	M	0.0	1.755	21	2
8	8.5	7.6	-2.4	-2.3	-5.9	-2.3	-5.9	N	0.0	-0.42	M	0.0	1.755	11	3
9	11.5	16.8	1.1	-1.6	-5.2	-1.6	-5.2	N	0.0	-0.42	M	0.0	1.755	11	4
1970	-16.0	-6.8	-0.1	-3.8	-7.4	-3.8	-7.4	N	0.0	-0.42	M	0.0	1.755	11	5
1	-0.4	-6.0	4.0	11.2	7.6	11.8	8.6	N	0.0	-0.42	0.35H	1.449	3.19	13	6
2	11.8	3.0	-8.0	7.0	3.5	1.4	-0.9	0.5C	-0.47	-0.78	0.35L	-1.167	0.59	42	7
3	8.3	-4.8	0.3	-0.8	-4.4	1.8	-2.3	0.4W	0.25	-0.23	M	0.0	1.755	31	8
4	-11.5	-9.6	-10.2	-1.8	-5.3	0.2	-3.9	0.4W	0.25	-0.23	0.35L	-1.167	0.59	32	9
5	-10.0	-8.4	-9.5	-6.3	-9.8	-7.0	-10.4	N	0.0	-0.42	0.35L	-1.167	0.59	12	10
6	2.6	7.2	4.1	4.0	0.5	6.6	2.6	0.4W	0.25	-0.23	(N)	0.0	1.755	31	11
7	11.1	6.9	6.3	3.9	0.4	5.9	1.8	0.4W	0.25	-0.23	0.35L	-1.167	0.59	32	12
8	-20.0	-12.7	-0.1	1.0	-2.6	2.9	-1.1	0.4W	0.25	-0.23	0.35L	-1.167	0.59	32	13
9	7.6	6.7	9.2	7.6	4.1	7.0	3.6	N	0.0	-0.42	0.35L	-1.167	0.59	12	14
1980	21.4	24.1	10.4	13.2	9.7	16.6	12.6	0.4W	0.25	-0.23	0.35H	1.449	3.19	33	15

RIVER BASIN: Stikine

MONTH: June

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	-1.4	-0.1	-6.4	4.5	0.6	4.5	0.6	N	0.0	-0.22	N	0.0	0.41	11	1
7	(57.9)	43.1	20.4	22.3	18.4	28.7	24.8	0.4W	0.417	0.20	0.35L	-2.23	-1.86	32	2
8	-35.7	-9.0	-5.2	20.2	16.3	22.4	18.1	N	0.0	-0.22	0.35H	2.76	3.21	13	3
9	-9.7	8.2	-27.2	-49.2	-53.2	-42.8	-46.8	0.4W	0.417	0.20	0.35L	-2.23	-1.86	32	4
1970	16.5	-8.6	-22.8	0.8	-3.2	8.9	5.0	0.4W	0.417	0.20	N	0.0	0.41	31	5
1	4.1	39.2	15.3	29.0	25.0	35.3	31.4	0.4W	0.417	0.20	0.35L	-2.23	-1.86	32	6
2	29.0	27.8	29.0	69.1	65.2	71.3	67.0	N	0.0	-0.22	0.35H	2.76	3.21	13	7
3	13.1	-25.3	-6.4	3.7	-0.2	5.9	1.6	N	0.0	-0.22	0.35H	2.76	3.21	13	8
4	-45.4	-19.6	13.3	6.3	2.3	12.7	8.7	0.4W	0.417	0.20	0.35L	-2.23	-1.86	32	9
5	-47.8	-23.4	-9.5	-7.5	-7.4	-9.4	-13.4	(0.4L)	-0.417	-0.6399	(0.35H)	2.76	3.21	23	10
6	-15.2	-23.1	-7.1	-18.8	-22.7	-8.5	-12.3	0.4W	0.417	0.20	0.35H	2.76	3.21	33	11
7	-2.8	-16.6	-16.1	-33.0	-36.9	-30.8	-35.1	N	0.0	-0.22	0.35H	2.76	3.21	13	12
8	-45.1	-22.1	-26.1	-14.0	-18.0	-11.8	-16.1	N	0.0	-0.22	0.35H	2.76	3.21	13	13
9	2.8	4.4	1.7	5.0	1.0	3.2	-0.6	N	0.0	-0.22	0.35L	-2.23	-1.86	12	13
1980	-15.6	-11.4	-13.1	-51.8	-55.8	-45.5	-49.4	0.4W	0.417	0.20	0.35L	-2.23	-1.86	32	15

RIVER BASIN: Stikine

MONTH: July

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	9.4	1.7	0.4	3.0	4.4	4.4	5.9	0.4C	-0.36	-0.546	0.35H	3.75	8.13	23	1
7	-23.5	-26.3	-29.1	-31.1	-29.7	-31.4	-30.0	0.4W	0.36	0.136	M	0.0	4.13	31	2
8	0.3	-14.2	-15.3	-11.6	-10.2	-11.6	-10.2	(N)	0.0	-0.205	(N)	0.0	4.13	11	3
9	-42.7	-49.8	-46.1	-48.5	-47.1	-49.4	-48.0	N	0.0	-0.205	0.35L	-3.12	0.78	12	4
1970	-14.2	1.1	1.5	1.1	1.5	2.6	4.0	0.4C	-0.36	-0.546	0.35H	3.75	8.13	23	5
1	-29.2	-36.7	-25.7	-24.6	-23.2	-23.2	-21.7	0.4C	-0.36	-0.546	0.35H	3.75	8.13	23	6
2	-12.3	5.3	0.4	-2.0	-0.6	-0.6	0.9	0.4C	-0.36	-0.546	0.35H	3.75	8.13	23	7
3	15.1	1.8	-1.3	2.9	4.3	2.9	4.3	N	0.0	-0.205	M	0.0	4.13	11	8
4	34.0	40.0	33.3	33.3	39.7	34.4	35.9	N	0.0	-0.205	0.35H	3.75	8.13	13	9
5	17.2	6.3	1.1	2.3	3.7	3.4	4.9	N	0.0	-0.205	0.35H	3.75	8.13	13	10
6	35.5	38.1	28.3	25.5	26.9	26.6	28.1	N	0.0	-0.205	0.35H	3.75	8.13	13	11
7	16.1	24.3	27.3	15.6	17.1	16.4	17.9	0.4W	0.36	0.136	0.35H	3.75	8.13	33	12
8	(-52.0)	-33.6	-31.7	-23.7	-22.3	-24.9	-23.6	0.4W	0.36	0.136	0.35L	-3.12	0.78	32	13
9	14.7	26.8	30.8	23.5	24.9	24.6	26.1	N	0.0	-0.205	0.35H	3.75	8.13	13	14
1980	7.3	14.7	1.1	-6.7	-5.3	-5.6	-4.1	N	0.0	-0.205	0.35H	3.75	8.13	13	15

RIVER BASIN: Stikine

MONTH: August

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	6.3	2.1	0.1	-3.1	-2.4	-3.1	-2.4	N	0.0	-0.13	N	0.0	0.27	11	1
7	-10.5	-2.0	+6.9	2.7	3.5	0.8	1.6	0.4W	0.36	0.219	N	0.0	0.27	31	2
8	-15.1	-6.4	-6.6	-12.9	-0.1	-15.2	-14.4	0.4W	0.36	0.219	0.35L	-2.37	-2.26	32	3
9	20.2	11.7	6.5	-7.1	-6.4	-7.1	-6.4	N	0.0	-0.13	N	0.0	0.27	11	4
1970	8.5	-13.9	11.4	7.2	7.9	6.8	7.5	N	0.0	-0.13	0.35L	-2.37	-2.25	12	5
1	-8.3	-8.7	-14.9	-4.1	-3.4	-6.4	-5.6	0.5W	0.36	0.219	0.35L	-2.37	-2.26	32	6
2	4.0	-7.7	-11.1	-4.3	-3.6	-2.4	-1.7	0.4C	-0.36	-0.48	N	0.0	0.27	21	7
3	-1.1	5.5	+0.3	-4.2	-3.5	-6.2	-5.4	0.4W	0.36	0.219	N	0.0	0.27	31	8
4	34.2	32.4	31.0	36.2	36.9	36.6	37.4	N	0.0	-0.13	0.35H	2.79	3.43	13	9
5	7.0	-0.7	4.3	-4.9	-4.1	-6.3	-5.5	0.4W	0.36	0.219	0.35H	2.79	3.43	33	10
6	23.4	22.6	21.3	21.3	22.0	20.9	21.6	N	0.0	-0.13	0.35L	-2.37	-2.26	12	11
7	1.3	-5.3	3.8	6.2	7.0	6.7	7.5	N	0.0	-0.13	0.35H	2.79	3.43	13	12
8	-15.2	-15.2	-13.7	-14.5	-13.8	-14.9	-14.2	N	0.0	-0.13	0.35L	-2.37	-2.26	12	13
9	-15.0	-7.1	-0.1	6.8	7.5	7.2	8.0	N	0.0	-0.13	0.35H	2.79	34.3	13	14
1980	11.8	19.4	17.3	6.1	6.9	5.8	6.5	N	0.0	-0.13	0.35L	-2.37	-2.26	12	15

RIVER BASIN: Upper Peace

MONTH: May

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1968	1.1	-9.6	-4.1	-4.0	-2.3	-4.0	-2.3	N	0.0	0.236	M	0.0	1.757	11	1
9	-3.5	-0.2	1.6	-2.1	-0.3	-2.1	-0.3	N	0.0	0.236	M	0.0	1.757	11	2
1970	-9.1	-11.7	-5.6	-6.2	-4.4	-6.2	-4.4	N	0.0	0.236	M	0.0	1.757	11	3
1	-3.1	2.0	-4.0	-5.0	-3.2	-4.5	-2.8	N	0.0	0.236	0.35H	3.76	5.41	13	4
2	11.2	9.1	4.3	10.0	11.7	8.0	9.5	0.4C	-0.306	-0.098	M	0.0	1.757	21	5
3	6.5	1.8	-4.3	-5.5	-3.7	-3.5	-1.5	0.4W	0.306	0.569	M	0.0	1.757	31	6
4	0.1	-3.8	8.0	6.3	8.1	6.0	7.8	N	0.0	0.236	0.35L	-2.84	-0.825	12	7
5	-10.1	-2.1	-2.5	0.8	2.6	0.5	2.2	N	0.0	0.236	0.35L	-2.84	-0.825	12	8
6	6.9	-0.7	-4.7	-10.4	-8.6	-8.7	-6.8	0.4W	0.306	0.596	0.35L	-2.84	-0.825	32	9
7	4.0	3.7	4.4	-9.7	-7.9	-8.0	-6.0	0.4W	0.306	0.596	0.35L	-2.84	-0.825	32	10
8	-14.3	-6.6	-0.3	-4.0	-2.3	-2.4	-0.4	0.4W	0.306	0.596	0.35L	-2.84	0.825	32	11
9	-5.8	-3.1	1.0	6.6	8.4	6.3	8.0	N	0.0	0.236	0.35L	-2.84	-0.825	12	12
1980	-8.0	-0.1	-2.0	-8.2	-6.4	-5.7	-3.8	0.4W	0.306	0.596	0.35M	3.76	5.41	33	13
1981	23.5	20.7	7.7	6.0	7.8	6.5	8.2	N	0.0	0.236	0.35H	3.76	5.41	13	14

RIVER BASIN: Upper Peace

MONTH: June

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1968	-2.3	11.8	11.8	13.2	13.4	13.2	13.4	N	0.0	0.229	0.35H	6.04	11.344	13	1
9	-10.6	-6.7	-5.7	-7.3	-7.1	-7.0	-6.7	0.4W	0.278	0.501	0.35L	-.457	0.887	32	2
1970	5.0	2.4	0.6	0.9	1.1	1.3	1.5	0.4W	0.278	0.501	0.35L	-4.57	0.887	32	3
1	1.6	-4.4	-3.6	-4.2	-4.0	-3.9	-3.7	0.4W	0.278	0.501	0.35L	-4.57	0.887	32	4
2	(29.2)	15.9	15.3	14.5	14.8	14.5	14.7	N	0.0	0.229	0.35H	6.04	11.344	13	5
3	7.0	7.3	7.4	8.2	8.4	8.2	8.4	N	0.0	0.229	M	0.0	5.414	11	6
4	1.6	3.1	3.9	2.9	3.1	2.9	3.1	N	0.0	0.229	0.35L	-4.57	0.887	12	7
5	-8.9	-5.7	-5.2	-5.3	-5.1	-5.4	-5.2	N	0.0	0.229	0.35H	6.04	11.344	13	8
6	7.9	2.9	3.9	5.9	6.1	6.3	6.5	0.4W	0.278	0.501	0.35L	-.457	0.887	32	9
7	-5.1	-13.1	-13.6	-13.6	-13.4	-13.7	-13.5	N	0.0	0.229	0.35H	5.04	11.344	13	10
8	-11.7	-14.2	-14.3	-15.9	-15.7	-16.0	-15.8	N	0.0	0.229	0.35H	6.04	11.344	13	11
9	4.2	3.7	3.5	3.3	3.5	3.3	3.5	N	0.0	0.229	0.35L	-4.57	0.887	12	12
1980	(-22.3)	-12.9	-13.7	-14.1	-13.9	-14.1	-13.8	N	0.0	0.229	0.35L	-4.57	0.887	12	13
1981	0.7	11.0	10.5	9.6	9.8	9.5	9.7	N	0.0	0.229	0.35H	5.04	11.244	13	14

RIVER BASIN: Upper Peace

MONTH: July

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1968	1.7	10.2	10.7	17.5	14.7	17.5	14.7	N	0.0	-0.157	N	0.0	-1.786	11	1
9	-16.8	-14.1	-12.0	-12.0	-14.9	-12.0	-14.9	N	0.0	-0.157	N	0.0	-1.786	11	2
1970	11.2	6.9	0.5	13.0	10.2	8.5	5.1	0.4C	-0.278	0.466	0.35H	5.86	3.968	23	3
1	-1.4	-3.5	-2.6	-18.5	-21.3	-23.0	-26.3	-0.4C	-0.278	0.466	0.35H	5.86	3.968	23	4
2	4.0	7.4	111.1	36.1	33.3	31.6	28.3	0.4C	-0.278	-0.466	0.35H	5.86	3.969	23	5
3	2.4	2.6	0.0	16.9	14.1	16.9	14.1	N	0.0	-0.157	N	0.0	-1.786	11	6
4	17.6	9.7	12.3	41.7	38.9	46.3	44.0	0.4W	0.278	0.1518	0.35L	-4.45	-6.101	32	7
5	-2.4	-3.6	-3.6	-24.2	-27.0	-23.9	-26.7	N	0.0	-0.157	0.35H	5.86	3.968	13	8
6	21.2	16.8	18.0	30.7	27.9	31.0	28.2	N	0.0	-0.157	0.35H	5.86	3.968	13	9
7	5.2	9.0	9.1	29.1	26.3	33.7	31.5	0.4W	0.278	0.1518	0.35L	-4.45	-6.101	32	10
8	-16.3	-17.3	-10.8	-29.4	-32.2	-24.8	-27.1	0.4W	0.278	0.1518	0.35L	-4.45	-6.101	32	11
9	7.3	10.7	5.8	-5.0	-7.8	-4.8	-7.6	N	0.0	-0.157	0.35H	5.86	3.968	13	12
1980	-8.2	-6.6	-8.7	-2.7	-5.5	-2.4	-5.2	N	0.0	-0.157	0.35H	5.86	3.968	13	13
1981	-3.5	-6.2	-7.6	-31.9	-34.7	-36.4	-39.7	0.4C	-0.278	0.466	0.35H	5.86	3.968	23	14

RIVER BASIN: Lake of the Woods (Rainy Lake)

MONTH: April

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	54.6	25.3	26.2	26.8	27.1	27.3	24.7	0.4C	-0.584	-1.0398	M	0.0	-1.194	21	1
7	-10.2	0.8	-1.2	-1.4	-1.2	-1.0	0.3	0.4C	-0.584	-1.0398	M	0.0	-1.194	21	2
8	-20.6	-9.8	-6.2	-6.7	-6.5	-6.9	6.7	N	0.0	-.4154	0.35L	-2.34	-4.016	12	3
9	23.2	23.0	26.1	26.8	27.0	27.0	27.2	0.4C	-0.584	-1.0398	0.35L	-2.34	-4.016	22	4
1970	7.7	14.2	11.5	11.8	12.0	12.2	13.8	0.4C	-0.584	-1.0398	M	0.0	-1.194	21	5
1	15.2	19.2	18.8	19.2	19.4	19.4	19.7	N	0.0	-.4154	0.35H	2.87	2.785	13	6
2	33.6	19.0	20.5	20.8	21.0	20.8	21.0	N	0.0	-.4154	M	0.0	-1.194	11	7
3	-18.6	-4.7	-2.6	-3.3	-3.1	-4.1	-3.8	0.4W	0.584	0.2030	0.35L	-2.34	-4.016	32	8
4	11.1	8.4	7.2	7.3	7.5	7.6	8.2	0.4C	-0.584	-1.0398	0.35H	2.87	2.785	23	9
5	14.0	16.7	15.7	16.2	16.4	16.6	17.1	0.4C	-0.584	-1.0398	0.35H	2.87	2.785	23	10
6	-2.0	-3.0	-1.0	-1.2	-1.0	1.3	-1.0	N	0.0	-.4154	(M)	0.0	-1.194	11	11
7	-31.1	-21.1	-16.6	-17.7	-17.4	-17.3	-17.2	N	0.0	-.4154	0.35H	2.87	2.785	13	12
8	9.5	9.0	14.2	14.4	14.6	-13.9	14.5	N	0.0	-.4154	0.35L	-2.34	-4.016	12	13
9	3.7	1.6	-0.9	-1.2	-1.0	-1.2	-0.7	N	0.0	-.4154	0.35H	2.87	2.785	13	14
1980	-4.6	-6.0	-0.9	-1.5	-1.0	-1.5	-0.8	0.4C	-0.584	-1.0398	0.35L	-2.34	-4.016	22	15
1981	-24.3	-13.0	-10.8	-11.7	-11.5	-11.7	-11.2	N	0.0	-.4154	0.35H	2.87	2.785	13	16

RIVER BASIN: Lake of the Woods (Rainy Lake)

MONTH: May

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	(81.7)	63.6	64.4	62.4	61.5	62.4	61.5	N	0.0	-0.1	N	0.0	-8.21	11	1
7	-11.1	-0.5	-3.4	-3.0	-3.9	-2.4	-3.3	N	0.0	-0.1	0.35H	4.61	-3.91	13	2
8	-21.7	-13.1	-18.6	-18.4	-19.3	-19.7	-20.5	0.4W	0.64	0.49	N	0.0	-8.21	31	3
9	2.6	25.2	19.5	18.8	17.9	17.0	16.3	0.4W	0.64	0.49	0.35L	-3.84	-11.58	32	4
1970	35.8	23.1	14.3	14.4	13.5	13.1	12.3	0.4W	0.64	0.49	N	0.0	-8.21	31	5
1	0.5	18.9	17.9	17.3	16.4	17.9	17.0	N	0.0	-0.1	0.35H	4.61	-3.91	13	6
2	10.5	25.2	33.6	33.5	32.6	37.2	31.4	0.4W	0.64	0.49	N	0.0	-8.21	31	7
3	-23.2	-21.3	-17.2	-18.2	-19.1	-20.0	-20.7	0.4W	0.64	0.49	0.35L	-3.84	-11.58	32	8
4	40.5	23.9	15.5	16.4	15.5	17.0	16.1	N	0.0	-0.1	0.35H	4.61	-3.91	13	9
5	5.0	12.3	20.1	20.0	19.2	20.7	19.7	N	0.0	-0.1	0.35H	4.61	-3.91	13	10
6	-12.0	-9.8	-4.0	-2.3	-3.2	-1.7	-2.7	N	0.0	-0.1	0.35H	4.61	-3.91	13	11
7	-32.1	-31.9	-32.9	-32.1	-33.0	-32.6	-33.5	N	0.0	-0.1	0.35L	-3.84	-11.58	12	12
8	-12.1	7.0	5.0	5.5	4.6	5.0	4.2	N	0.0	-0.1	0.35L	-3.84	-11.58	12	13
9	43.5	16.2	10.9	11.5	10.6	11.0	10.2	N	0.0	-0.1	0.35L	-3.84	-11.58	12	14
1980	-23.4	-25.8	-15.7	-12.9	-13.8	-14.7	-15.4	0.4W	0.64	0.49	0.35L	-3.84	-11.58	32	15
1981	-28.2	-30.6	-25.9	-25.2	-26.1	-26.6	-27.3	0.4W	0.64	0.49	N	0.0	-8.21	31	16

RIVER BASIN: Lake of the Woods (Rainy Lake)

MONTH: June

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBA-BILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBA-BILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	73.4	52.4	50.4	52.1	51.2	52.0	51.1	0.4W	0.44	0.33	M	0.0	-10.03	31	1
7	-11.0	-3.8	-4.3	-3.7	-4.6	-4.3	-5.2	0.5W	0.84	0.80	0.35L	-3.76	-14.04	52	2
8	13.6	-4.7	-9.4	-11.0	-11.8	-11.4	-12.3	0.4W	0.44	0.33	0.35L	-3.76	-14.04	32	3
9	25.0	14.1	15.3	14.1	13.2	14.2	13.3	0.4C	-0.44	-0.73	M	0.0	-10.03	21	4
1970	68.3	52.2	51.8	52.1	51.3	51.8	50.9	N	0.0	-0.199	0.35L	-3.76	-14.04	12	5
1	-9.2	7.7	6.2	6.5	5.6	6.6	5.8	0.4C	-0.44	-0.73	M	0.0	-10.03	21	6
2	-14.5	-12.8	-12.7	-11.0	-11.8	-11.4	-12.3	0.4W	0.44	0.33	0.35L	-3.76	-14.04	32	7
3	-30.5	-31.3	-28.5	-30.3	-31.1	-30.7	-31.7	0.4W	0.44	0.33	0.35L	-3.76	-14.04	32	8
4	65.1	51.0	48.9	49.9	49.0	50.4	49.7	0.46	-0.44	-0.73	0.35H	4.30	-4.87	23	9
5	-9.6	7.0	2.1	3.6	2.7	4.0	3.2	N	0.0	-0.199	(0.35HO	4.30	-4.87	13	10
6	-25.7	-19.5	-22.2	-21.8	-22.6	-22.2	-23.1	0.4W	0.44	0.33	0.35L	-3.76	-14.04	32	11
7	-39.9	-16.1	-18.5	-22.0	-22.9	-22.5	-23.4	0.4W	0.44	0.33	0.35L	-3.76	-14.04	32	12
8	3.0	-4.6	-2.2	-2.6	-3.4	-3.0	-3.9	0.4W	0.44	0.33	0.35L	-3.76	-14.04	32	13
9	31.6	38.8	42.5	43.3	42.4	42.8	41.9	0.4W	0.44	0.33	0.35L	-3.76	-14.04	32	14
1980	-35.6	-37.8	-34.6	-33.9	-34.7	-33.6	-34.4	0.4W	0.44	0.33	0.35H	4.30	-4.87	33	15
1981	-26.2	-31.5	-36.0	-37.5	-37.9	-37.5	-38.4	0.4W	0.44	0.33	0.35L	-3.76	-14.04	32	16

RIVER BASIN: Lake of the Woods (Rainy Lake)

MONTH: July

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBA-BILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBA-BILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	38.0	31.2	27.7	28.1	28.5	28.6	29.2	0.4W	0.39	0.57	M	0.0	-4.35	31	1
7	-2.8	-9.6	-7.4	-8.1	-7.7	-7.9	-7.5	N	0.0	0.11	0.35L	-4.0	-8.20	12	2
8	53.1	14.3	15.7	17.5	17.9	18.1	18.6	0.4W	0.39	0.57	(M)/L	0.0	-4.35	31	3
9	-1.7	16.8	16.8	19.9	20.3	19.3	19.7	0.4C	-0.39	-0.35	M	0.0	-4.35	21	4
1970	60.9	51.5	47.5	45.8	46.2	46.6	47.2	0.4W	0.39	0.57	0.35L	-4.0	-8.20	32	5
1	-12.4	-11.4	-8.3	-8.2	-7.8	-8.2	-7.8	N	0.0	0.11	M	0.0	-4.35	11	6
2	-22.0	-23.9	-22.6	-21.5	-21.0	-21.5	-21.0	N	0.0	0.11	M	0.0	-4.35	11	7
3	-32.4	-20.3	-20.2	-18.6	-18.2	-18.6	-18.2	N	0.0	0.11	M	0.0	-4.35	11	8
4	-47.3	48.9	48.2	47.3	47.7	48.1	48.6	0.4W	0.39	0.57	0.35L	-4.0	-8.20	32	9
5	-24.4	1.5	-1.2	-1.6	-1.1	-1.3	-0.8	0.4W	0.39	0.57	0.35H	4.67	0.14	33	10
6	-24.7	-20.3	-21.5	-22.8	-22.4	-22.0	-21.4	0.4W	0.39	0.57	0.35L	-4.0	-8.20	32	11
7	-39.2	-17.7	-18.5	-16.3	-15.8	-16.8	-16.5	0.4C	-0.39	-0.35	(N)	0.0	-4.35	21	12
8	18.0	-1.6	-2.9	-1.3	-0.8	-1.5	-1.1	N	0.0	0.11	0.35H	4.67	0.14	13	13
9	0.0	19.8	16.6	16.0	16.5	16.3	16.8	0.4W	0.39	0.57	0.35H	4.67	0.14	33	14
1980	-35.0	-36.9	-34.6	-34.6	-34.2	-34.4	-33.9	N	0.0	0.11	0.35L	-4.0	-8.20	12	15
1981	-17.9	-14.3	-19.5	-18.3	-17.9	-18.6	-18.2	N	0.0	0.11	0.35H	4.67	0.14	13	16

RIVER BASIN: Madawaska

MONTH: March

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	5.3	13.5	7.2	-1.1	0.8	0.0	0.8	N	0.0	0.36	0.35H	3.17	3.72	13	1
7	9.4	-7.8	7.8	8.8	9.1	6.6	6.3	0.4C	-0.76	-0.47	0.35H	3.17	3.72	23	2
8	-3.8	9.0	4.4	0.5	0.8	-3.6	1.9	0.4C	-0.76	-0.47	0.35L	-2.64	-2.02	22	3
9	-15.8	-8.0	-1.3	-4.5	-4.3	-5.4	-5.6	N	0.0	0.36	0.35L	-2.64	-2.02	12	4
1970	-16.1	-23.2	-8.7	-7.4	7.1	-11.5	-6.0-	0.4C	-0.76	-0.47	0.35L	-2.64	-2.02	22	5
1	-15.2	-12.6	-8.6	-6.6	-6.3	-2.3	-0.2	0.4W	0.76	1.18	0.35H	3.17	3.72	33	6
2	-19.6	-19.7	-6.5	-6.4	-6.1	-9.6	-6.7	0.4C	-0.76	-0.47	M	0.0	0.55	21	7
3	46.3	42.0	12.0	11.1	11.4	14.3	12.0	0.4W	0.76	1.18	M	0.0	0.55	31	8
4	-8.2	0.5	6.9	8.0	8.3	7.1	7.0	N	0.0	0.36	0.35L	-2.64	-2.02	12	9
5	-10.2	-14.7	-2.9	-5.3	-5.0	-1.0	1.1	0.4W	0.76	1.18	0.35H	3.17	3.72	33	10
6	42.5	17.1	0.2	-4.8	-4.6	-7.0	-7.4	0.4C	-0.76	-0.47	0.35H	3.17	3.72	23	11
7	8.5	17.6	-2.0	-5.7	-5.4	-3.3	-9.1	0.4W	0.76	1.18	0.35L	-2.64	-2.02	32	12
8	-13.4	-5.9	2.3	7.6	7.9	10.0	4.1	0.4W	0.76	1.18	0.35L	-2.64	-2.02	32	13
9	21.4	8.8	-3.5	2.5	1.8	3.6	4.4	N	0.0	0.36	0.35H	3.17	3.72	13	14
1980	-5.8	13.3	6.4	7.5	7.8	7.5	7.8	N	0.0	0.36	(N)	0.0	0.55	11	15
1981	32.9	27.8	40.2	24.8	25.1	29.1	31.2	0.4W	0.76	1.18	0.35H	3.17	3.72	33	16

RIVER BASIN: Madawaska MONTH: April

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	-17.9	-21.1	-8.0	-5.8	-7.3	-7.7	-9.3	0.4C	-0.48	-0.75	0.35H	3.22	3.81	23	1
7	6.7	4.5	-2.4	6.1	4.6	6.1	4.6	N	0.0	-0.23	M	0.0	-0.15	11	2
8	-15.6	-14.1	-20.3	-21.8	-23.4	-17.7	-18.9	0.4W	0.48	0.25	0.35H	3.22	3.81	33	3
9	17.5	20.1	-8.9	-4.6	-6.1	-7.6	-9.5	0.4C	-0.48	-0.75	M	0.0	-0.15	21	4
1970	-34.0	-10.6	-19.9	-7.4	-8.9	-10.4	-12.3	0.4C	-0.48	-0.75	M	0.0	-0.15	21	5
1	26.6	-11.1	-2.7	12.5	11.0	13.7	12.4	N	0.0	-0.23	0.35H	3.22	3.81	13	6
2	-32.3	-10.1	-7.3	14.4	12.9	14.4	12.9	N	0.0	-0.23	M	0.0	-0.15	11	7
3	34.5	45.2	48.1	31.0	29.4	34.0	32.6	0.4W	0.48	0.25	M	0.0	-0.15	31	8
4	48.7	29.2	9.4	10.8	9.2	15.0	11.2	0.4W	0.48	0.25	0.35H	3.22	3.81	33	9
5	-28.1	-33.0	-8.5	2.2	0.6	6.4	2.6	0.4W	0.48	0.25	0.35H	3.22	3.81	33	10
6	58.3	61.9	53.3	63.9	62.3	66.0	64.3	0.4W	0.48	0.25	0.35L	-2.67	-3.40	32	11
7	-13.4	-8.3	-2.8	-14.2	-15.8	-14.2	-15.8	N	0.0	-0.23	(N)	0.0	-0.15	11	12
8	-19.9	6.3	19.9	20.1	18.5	18.1	16.5	0.4C	-0.48	-0.75	0.35H	3.22	3.81	23	13
9	36.2	14.3	16.2	8.3	6.8	12.5	11.3	0.4W	0.48	0.25	0.35H	3.22	3.81	33	14
1980	31.7	35.4	26.8	17.2	15.7	21.4	20.2	0.4W	0.48	0.25	0.35H	3.22	3.81	33	15
1981	-9.4	-6.4	-3.6	-18.3	-19.8	-17.1	-18.4	N	0.0	-0.23	0.35H	3.22	3.81	13	16

RIVER BASIN: Madawaska

MONTH: May

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBA-BILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBA-BILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	-5.9	-2.0	-16.7	6.4	6.5	11.3	11.4	0.4W	0.53	0.19	0.35H	3.86	4.92	33	1
1977	-34.3	-26.8	1565	3.9	4.0	2.4	2.2	0.4W	0.53	0.19	0.35L	-3.11	-2.44	32	2
8	-60.1	-58.5	-51.7	-35.2	-35.1	-35.2	-35.1	M	0.0	-0.31	M	0.0	0.89	11	3
9	32.1	54.9	46.9	14.5	14.5	14.5	14.5	M	0.0	-0.31	M	0.0	0.89	11	4
1970	32.1	38.1	8.3	8.0	8.1	9.3	9.3	0.4W	0.53	0.19	M	0.0	0.89	31	5
1	11.1	8.6	20.8	49.8	49.9	51.1	51.1	0.4W	0.53	0.19	M	0.0	0.89	31	6
2	103.5	80.8	75.6	77.6	77.7	76.0	75.8	0.4W	0.53	0.19	0.35I	-3.11	-2.44	32	7
3	-15.7	-20.7	-14.8	-37.0	36.9	-35.7	-35.7	0.4W	0.53	0.19	M	0.0	0.89	31	8
4	50.0	21.3	17.9	1.4	1.4	-1.5	-1.6	N	0.0	-0.31	0.35L	-3.11	-2.44	12	9
5	-2.1	24.1	36.4	54.4	54.5	51.6	51.4	N	0.0	-0.31	0.35L	-3.11	-2.44	12	10
6	-22.9	-18.0	-27.7	-15.8	-15.7	-10.9	-10.8	0.4W	0.53	0.19	0.35H	3.86	4.92	33	11
7	-58.0	-71.6	-50.4	-40.1	-40.1	-37.9	-37.6	0.4C	-0.53	-0.81	0.35H	3.86	4.92	23	12
8	43.0	30.5	21.1	32.9	33.0	35.2	35.5	0.4C	-0.53	-0.81	0.35H	3.86	4.92	23	13
9	1.1	10.6	-26.4	-30.7	-30.6	-27.1	-26.9	N	0.0	-0.31	0.35H	3.86	4.92	13	14
1980	-31.7	-20.5	-3.9	-16.1	-16.0	-17.6	-17.9	0.4W	0.53	0.19	0.35L	-3.11	-2.44	32	15
1981	-16.4	-24.4	-24.4	-48.7	-48.6	-45.1	-44.9	N	0.0	-0.31	0.35H	3.86	4.92	13	16

RIVER BASIN: Madawaska

MONTH: June

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1966	24.6	19.6	22.5	19.0	20.8	18.5	20.2	N	0.0	0.14	0.35L	-4.76	13.43	12	1
7	35.4	32.5	29.0	17.8	19.7	17.3	19.1	N	0.0	0.14	0.35L	-4.76	13.43	12	2
8	-4.8	-4.5	-5.5	-7.5	-5.7	-8.4	-6.7	0.4W	0.34	0.51	0.35L	-4.76	13.43	32	3
9	4.8	17.8	16.6	12.7	14.5	13.7	15.6	0.4C	-0.34	-0.23	0.35H	6.04	25.64	23	4
1970	-1.7	0.4	-1.0	1.5	3.3	1.8	3.7	0.4C	-0.34	-0.23	M	0.0	19.13	21	5
1	-11.9	0.1	-0.7	-4.1	-2.3	-4.1	-2.3	N	0.0	0.14	M	0.0	19.13	11	6
2	7.7	1.5	-1.9	-1.6	0.3	-1.6	0.3	N	0.0	0.14	M	0.0	19.13	11	7
3	23.5	16.1	16.2	12.2	14.0	12.5	14.4	0.4C	-0.34	-0.23	M	0.0	19.13	21	8
4	0.0	-4.4	3.0	-1.3	0.5	-0.3	1.6	0.4C	-0.34	-0.23	0.35H	6.04	25.64	23	9
5	-7.9	-4.3	0.8	-0.0	1.9	0.7	2.5	N	0.0	0.14	0.35H	6.04	25.64	13	10
6	-10.5	-11.2	-12.5	-9.3	-7.5	-18.7	-6.8	N	0.0	0.14	0.35H	6.04	25.64	13	11
7	-21.0	-23.0	-20.4	-21.4	-19.4	-21.7	-20.0	N	0.0	0.14	0.35L	-4.76	13.43	12	12
8	2.0	-0.8	-2.5	-3.0	-1.2	-3.9	-2.2	0.4W	0.34	0.51	0.35L	-4.76	13.43	32	13
9	-1.3	-2.7	-4.1	0.8	2.6	1.0	2.9	0.9W	0.34	0.51	0.35H	6.04	25.64	33	14
1980	1.7	-1.3	-6.0	09.9	-8.1	-9.6	-7.8	0.4W	0.34	0.51	0.35H	6.04	25.64	33	15
1981	-1.3	3.6	5.8	3.9	5.7	4.5	6.4	N	0.0	0.14	0.35H	6.04	25.64	13	16

RIVER BASIN: Mersey

MONTH: April

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1969	49.5	-0.7	5.7	6.3	4.6	6.3	4.6	N	0.0	0.092	M	0.0	15.046	11	1
1970	-19.3	10.3	5.8	6.8	5.1	6.8	5.1	N	0.0	0.092	M	0.0	15.046	11	2
1	64.8	2.8	-0.4	0.9	-0.8	-0.1	-1.7	0.4W	0.39	0.423	M	0.0	15.046	31	3
2	-14.9	4.3	-4.8	-4.7	-6.4	-3.7	-5.6	0.4C	-0.39	-0.238	M	0.0	15.046	21	4
3	-36.5	-1.7	1.4	5.3	3.6	5.3	3.6	N	0.0	0.092	M	0.0	15.046	11	5
4	-26.5	-0.7	-0.5	0.3	-1.4	0.8	-1.0	N	0.0	0.092	0.35L	-4.79	10.48	12	6
5	4.3	2.3	0.7	0.6	-1.1	0.6	-1.1	N	0.0	0.092	M	0.0	15.046	11	7
6	-28.3	2.4	4.1	6.4	4.7	6.4	4.7	N	0.0	0.092	(N)	0.0	15.046	11	8
7	44.8	2.2	-3.0	2.1	0.4	1.5	-0.1	N	0.0	0.092	0.35H	5.58	20.09	13	9
8	1.1	4.3	4.0	3.0	1.3	2.5	0.8	N	0.0	0.092	0.35H	5.58	20.09	13	10
9	-28.7	-8.7	-6.7	-2.1	-3.8	-3.6	-5.1	0.4W	0.39	0.423	0.35H	5.58	20.09	33	11
1980	-16.7	-16.5	-6.7	-6.2	-7.9	-6.7	-8.4	N	0.0	0.092	0.35H	5.58	20.09	13	12
1981	4.4	-2.4	-1.6	1.5	-0.2	1.9	0.2	N	0.0	0.092	0.35L	-4.79	10.48	12	13

RIVER BASIN: Mersey

MONTH: May

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1969	-5.7	-9.8	-6.3	-5.2	-2.6	-5.4	-2.8	0.4C	-0.36	0.073	M	0.0	4.82	21	1
1970	-21.7	1.1	-12.7	1.7	4.3	1.6	4.2	0.4C	-0.36	0.072	M	0.0	4.82	21	2
1	32.0	27.1	-8.6	-15.5	-12.9	-15.7	-13.0	0.4C	-0.36	0.073	M	0.0	4.82	21	3
2	109.8	90.8	67.3	66.7	69.3	66.7	69.3	N	0.0	0.39	M	0.0	4.82	11	4
3	15.7	9.5	7.5	-0.5	2.1	2.1	4.7	N	0.0	0.39	0.35H	5.11	9.92	13	5
4	(-49.5)	-2.0	-23.3	-12.8	-10.2	-10.5	-7.8	0.4C	-0.36	0.073	0.35H	5.11	9.92	23	6
5	-6.1	24.0	35.8	39.9	42.5	42.3	44.9	0.4C	-0.36	0.073	0.35H	5.11	9.32	23	7
6	45.4	-22.4	-27.2	-22.4	-19.8	-22.4	-19.8	N	0.0	0.39	(N)	0.0	4.82	11	8
7	22.8	-37.2	-3.0	-28.2	-25.6	-25.8	-23.2	0.4C	-0.36	0.073	0.35H	5.11	9.92	23	9
8	-19.8	15.6	5.1	21.9	24.5	24.3	26.9	0.4C	-0.36	0.073	0.35H	5.11	9.92	23	10
9	-9.4	-17.2	9.4	-10.0	-7.3	-7.4	-4.8	N	0.0	0.39	0.35H	5.11	9.92	13	11
1980	-35.4	-48.2	-29.9	-21.4	-18.8	-18.7	-16.1	0.4W	0.36	0.712	0.35H	5.11	9.92	33	12
1981	-32.0	-8.3	-13.7	-25.1	-22.5	-27.2	-24.7	N	0.0	0.39	0.35L	-4.34	0.45	12	13

RIVER BASIN: Mersey

MONTH: June

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBA-BILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBA-BILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1969	-12.5	-9.7	-18.1	-25.2	-16.1	-32.2	-21.8	0.4C	-0.28	-0.003	M	0.0	17.12	21	1
1970	2.5	2.7	0.0	-24.3	-15.2	-17.4	-7.0	0.4W	0.28	0.557	M	0.0	17.12	31	2
1	5.7	1.5	17.3	23.3	32.4	30.3	40.6	0.4W	0.28	0.557	M	0.0	17.12	31	3
2	19.7	25.2	20.8	5.2	14.3	12.1	22.5	0.4W	0.28	0.557	M	0.0	17.12	31	6
3	25.8	23.3	15.1	-25.5	-16.4	-24.3	-15.2	N	0.0	0.277	0.35H	6.20	22.99	13	5
4	4.7	1.4	1.1	12.5	21.6	6.8	17.1	0.4C	-0.28	-0.003	0.35H	6.20	22.99	23	6
5	-14.7	-8.7	-9.4	-9.7	-0.6	-15.3	-5.1	(0.4C)	-0.28	-0.003	(0.35H)	6.20	22.99	23	7
6	-11.5	-14.1	-9.9	-57.0	47.9	-35.8	-46.8	N	0.0	0.277	0.35H	6.20	22.99	13	8
7	10.4	1.8	-14.4	12.8	21.9	5.8	16.2	0.4C	-0.28	-0.003	(N)	0.0	17.12	21	9
8	-18.6	-22.0	-3.2	-15.4	-6.3	-14.2	-5.1	N	0.0	0.277	0.35H	6.20	22.99	13	10
9	32.3	17.7	14.4	-7.4	1.7	-13.1	-2.8	0.4C	-0.28	-0.003	0.35H	6.20	22.99	23	11
1980	-33.8	-24.5	-9.1	6.3	2.8	-0.3	10.0	0.4W	0.28	0.557	(0.35L)	-4.73	12.34	32	12
1981	-10.1	25.6	15.5	2.7	11.8	10.9	21.2	0.4W	0.28	0.557	0.35H	6.20	22.99	33	13

RIVER BASIN: Mersey

MONTH: July

YEAR	Q-MEASURED DEVIATIONS	PERFECT FORECASTS	NO FORECASTS	NORMALS/MEANS USED AS FORECAST		IMPERF. FORECAST BASED ON NORMALS	IMPERF. FORECAST BASED ON MEANS	TEMPERATURE			PRECIPITATION			COMBINATION	NO.
								PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA	PROBABILITY	MEANS FOR C. NORMALS	MEANS FOR DATA		
1969	-21.9	-2.2	-5.1	0.2	2.5	0.2	2.5	0.4C	-0.334	-0.129	M	0.0	11.2	21	1
1970	-17.6	-4.2	0.5	-2.9	-0.6	-2.9	-0.6	0.4W	0.334	0.4365	M	0.0	11.2	31	2
1	-23.8	-28.8	-33.4	-32.8	-30.5	-32.8	-30.5	N	0.0	0.154	M	0.0	11.2	11	3
2	-2.2	9.5	19.1	17.6	19.9	17.5	19.8	0.4W	0.334	0.4365	(N)	0.0	11.2	31	4
3	83.2	78.9	75.1	57.5	59.8	57.5	59.8	0.4W	0.334	0.4365	M	0.0	11.2	31	5
4	-9.7	-14.5	-10.3	-10.1	-7.8	-8.9	-6.6	N	0.0	0.154	0.35H	5.97	17.177	13	6
5	-23.2	-8.0	-15.2	-10.1	-7.8	-8.9	-6.6	N	0.0	0.154	0.35H	5.97	17.177	13	7
6	58.0	36.4	27.2	28.7	31.0	30.0	32.3	N	0.0	0.154	0.35H	5.97	17.177	13	8
7	3.6	3.8	3.9	-7.5	-5.2	-6.3	-4.0	N	0.0	0.54	0.35H	5.97	17.177	13	9
8	-23.0	-27.3	-17.6	-15.0	-12.7	-13.8	-11.5	N	0.0	0.154	0.35H	5.97	17.177	13	10
9	-14.8	-26.8	-28.9	-30.7	-28.9	-30.7	-28.4	N	0.0	0.154	N	0.0	11.2	11	11
1980	-20.7	-18.7	-21.3	-14.5	-12.2	-13.2	-10.9	N	0.0	0.154	0.35H	5.97	17.177	13	12
1981	-4.5	6.1	5.7	-6.1	-3.8	-7.1	-4.9	0.4W	0.334	0.4365	0.35L	-4.588	6.159	32	13

APPENDIX 7

IMPROVEMENTS OF F-TEST AND r-COEFFICIENT
WITH THE INCREASING LENGTH OF RECORD

EXAMPLE: STIKINE-MAY

DEPENDENT VARIABLE: Q5

LAST YEAR CONSIDERED	NO. OF YEARS	VALUES OF REGRESSION COEFFICIENTS OF VARIABLES INCLUDED IN EQUATIONS						F-TEST SGN.	R
		CONST.	T3	T4	T5	PS4	P5		
1975	15	5.94	1.74	0.06	11.40	.18	0.42	1.601	.6861
1976	16	5.91	1.69	-.08	11.65	.18	.37	1.762	.6844
1977	17	6.08	1.72	.04	11.81	.18	.36	2.095	.6984
1978	18	5.18	1.70	-.32	11.15	.19	.57	2.544	.7173
1979	19	5.17	1.74	-.31	11.04	.19	.58	2.853	.7233
1980	20	4.79	1.75	-.47	10.49	.18	.56	3.739	.7562

APPENDIX 8

GRAPHICAL COMPARISON OF THE "IMPERFECT (ACTUAL) FORECAST BASED ON NORMALS" AND "NO FORECAST"

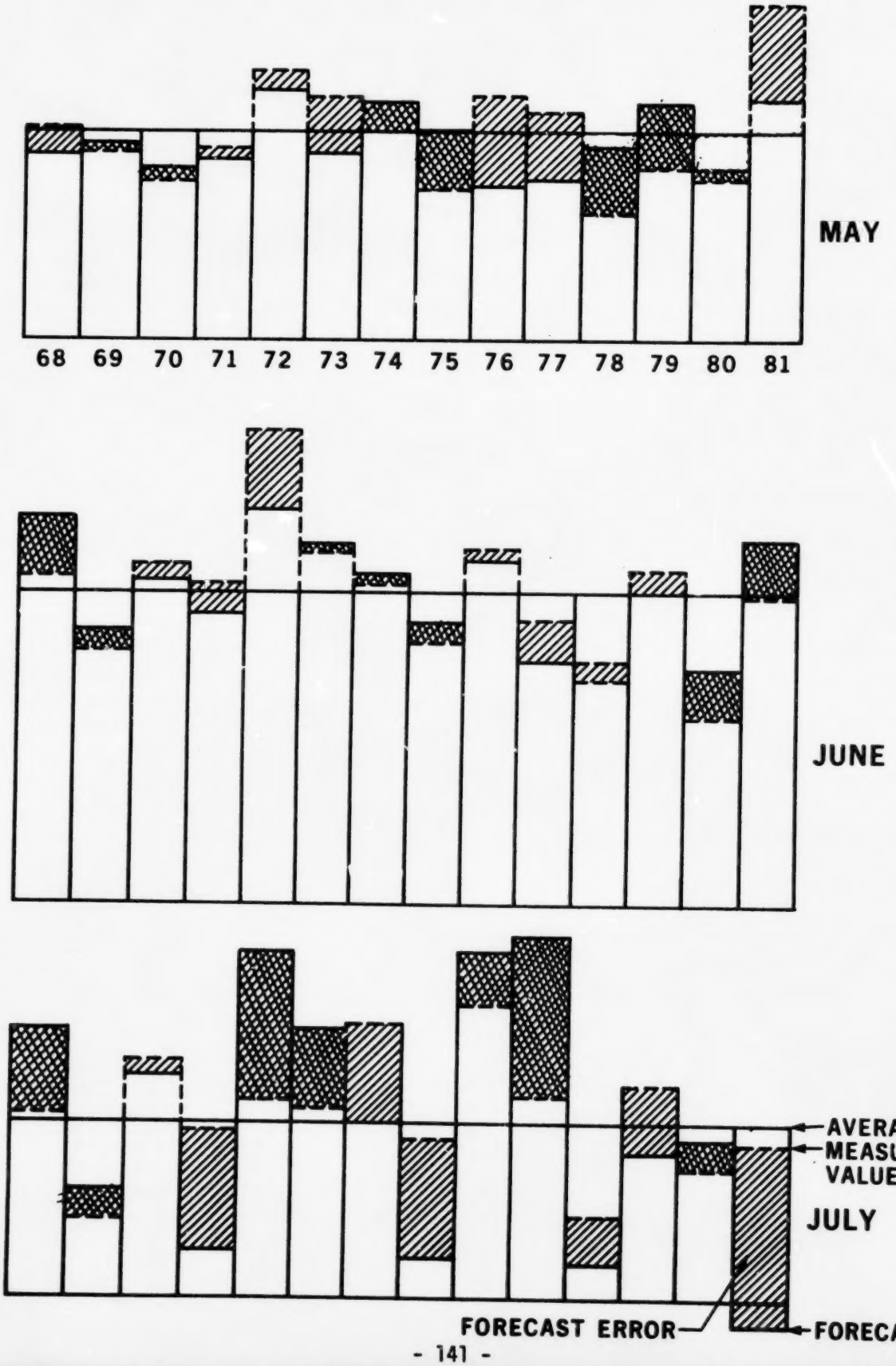
EXAMPLE: UPPER PEACE

NOTE:

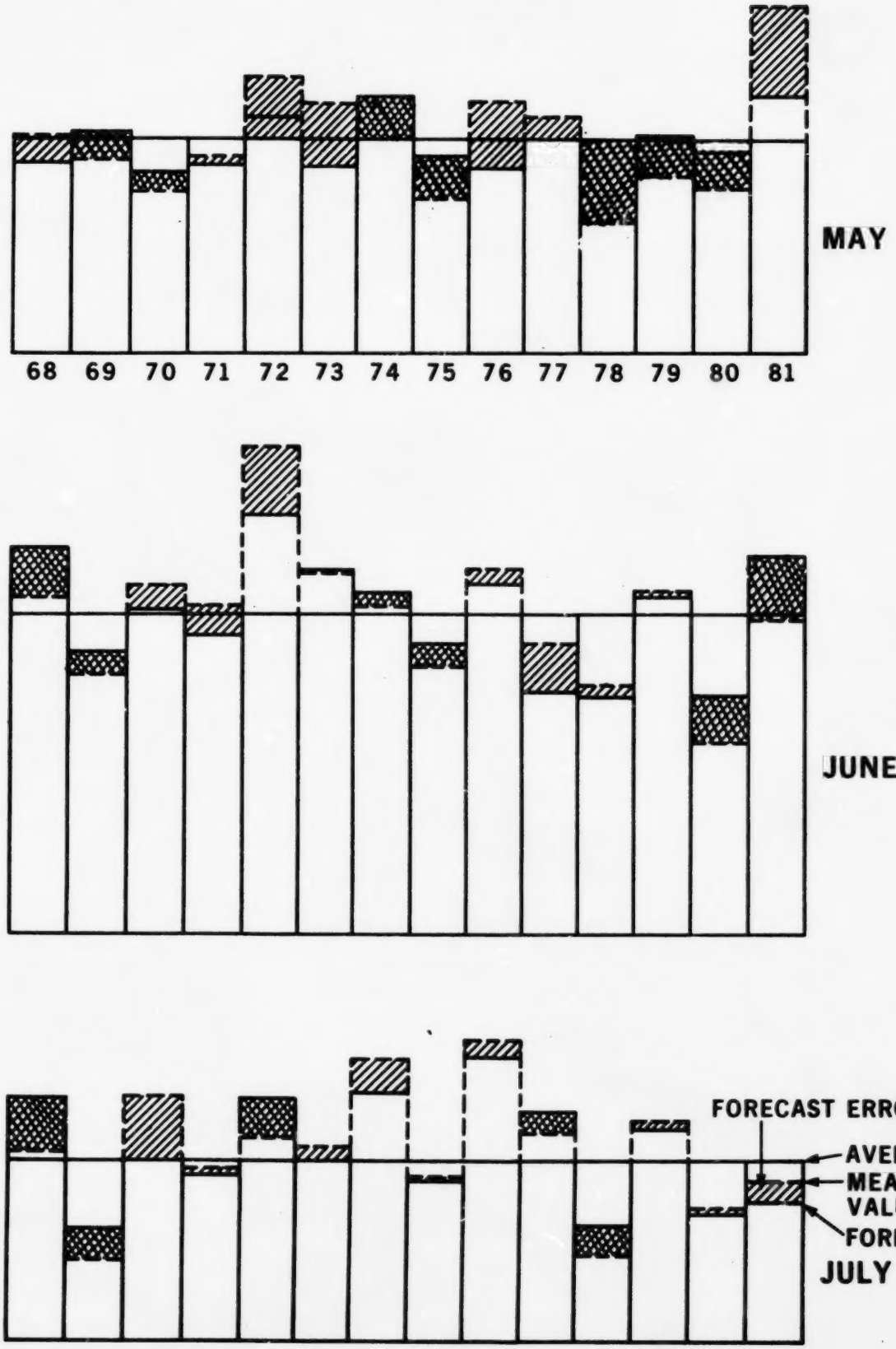
MEASURED VALUE IS GREATER THAN FORECAST

MEASURED VALUE IS LESS THAN FORECAST

PEACE RIVER
IMPERFECT FORECAST BASED ON NORMALS



PEACE RIVER
NO FORECAST



APPENDIX 9

COMPARISON OF SIX TYPES OF STREAMFLOW
FORECAST WITH THE MEASURED STREAMFLOW

#1 PERFECT FORECAST
#2 NO FORECAST
#3 NORMALS USED AS FORECAST
#4 MEANS USED AS FORECAST
#5 ACTUAL FORECAST BASED ON NORMALS
#6 ACTUAL FORECAST BASED ON MEANS

EXAMPLE: STIKINE
UPPER PEACE

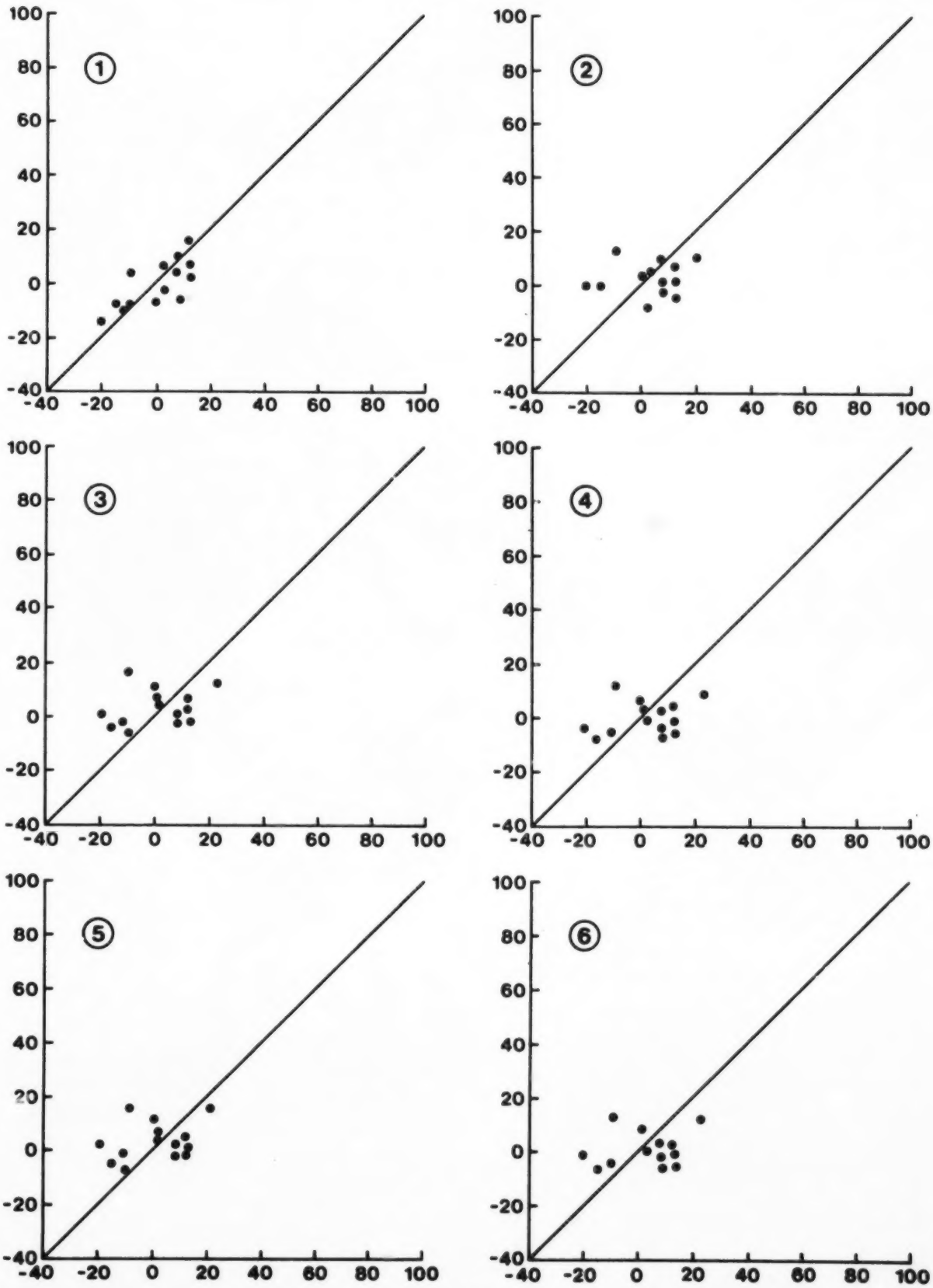
NOTE:

ALL CALCULATIONS AND MEASUREMENTS ARE DEPICTED AS RELATIVE VALUES
(DEVIATIONS FROM THE MEAN)

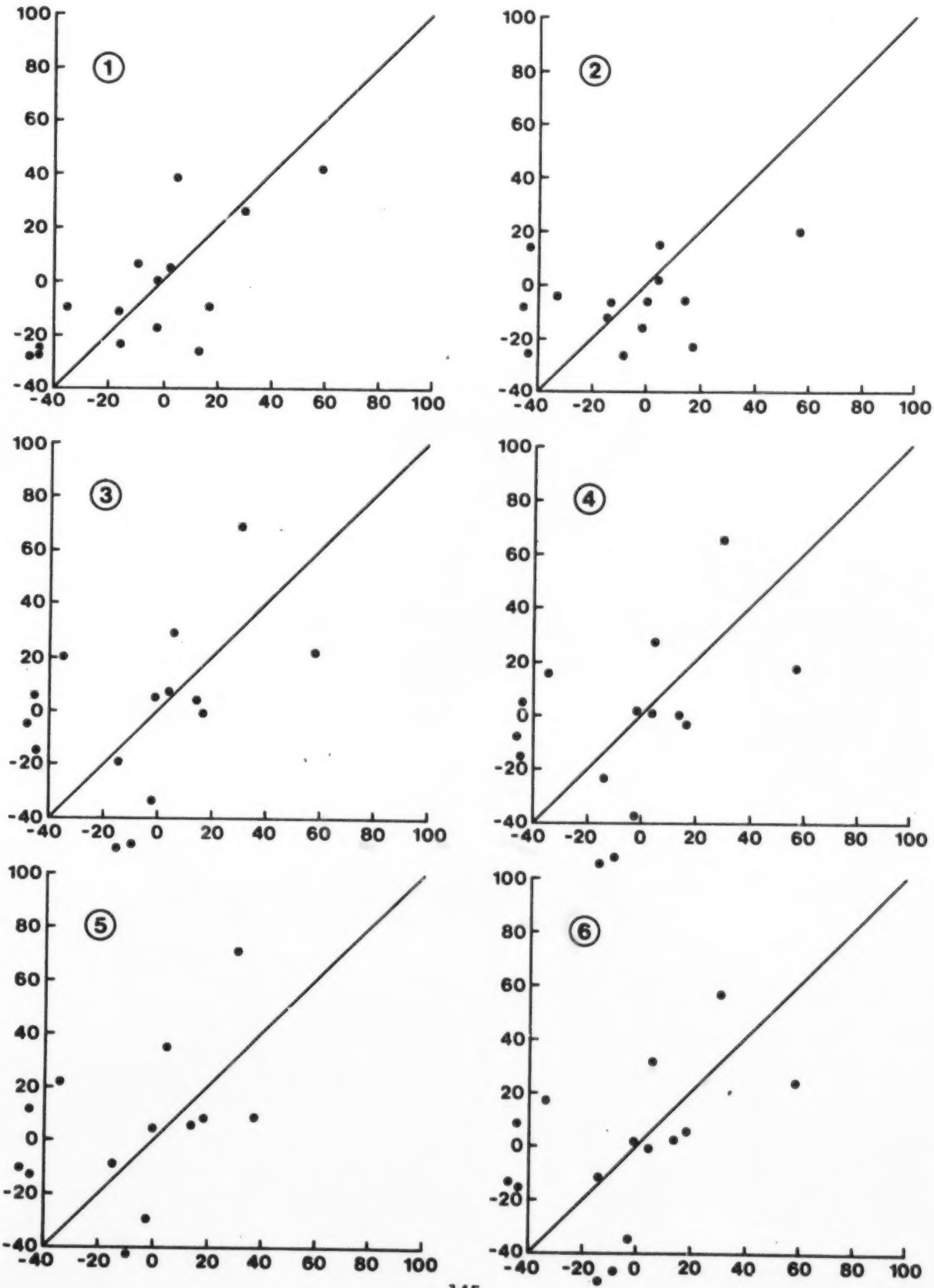
THE HORIZONTAL AXIS REPRESENTS THE MEASURED STREAMFLOW VALUES,
THE VERTICAL AXIS REPRESENTS THE FORECASTS

ALL VALUES IN MM

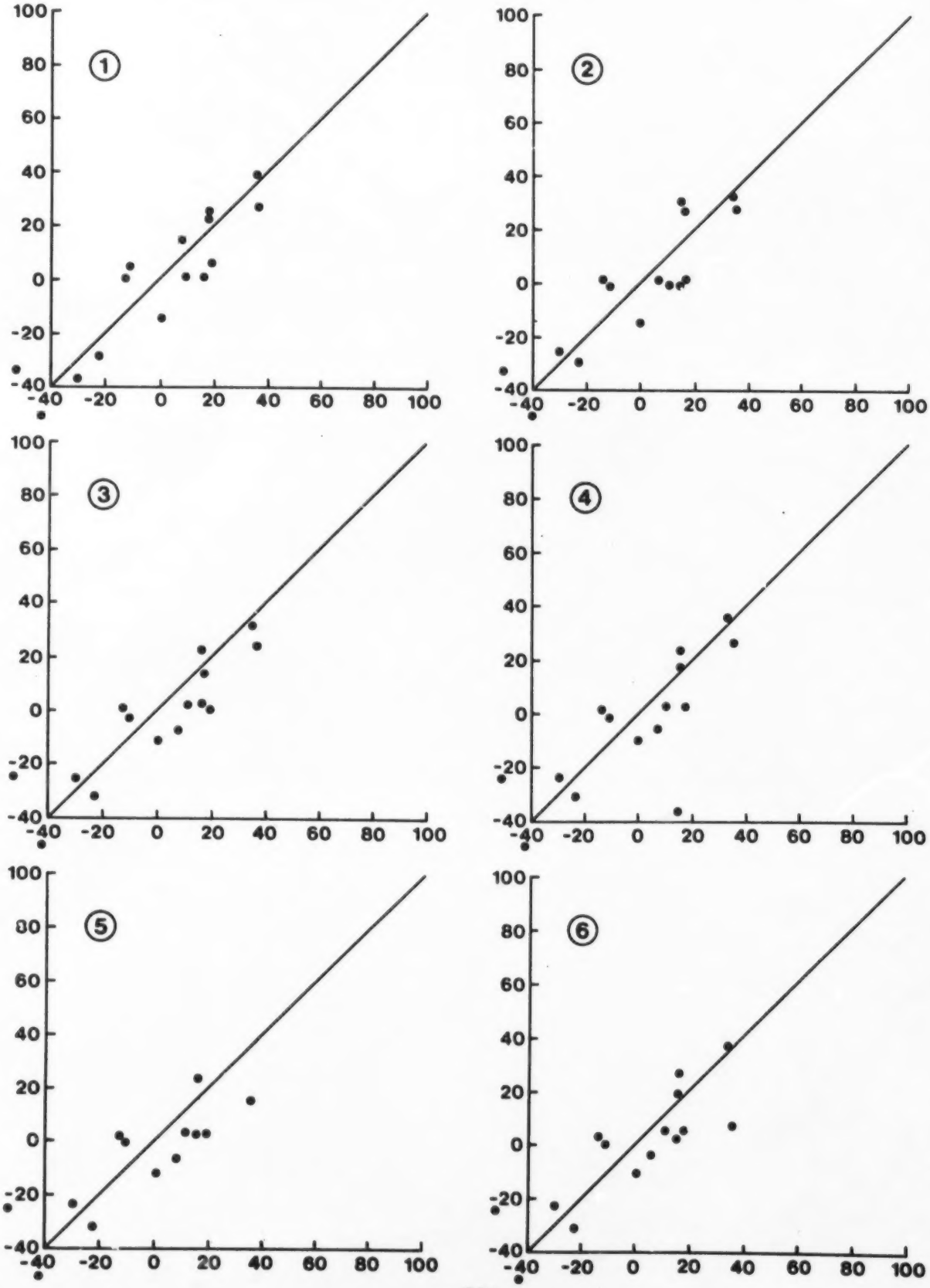
STIKINE - MAY



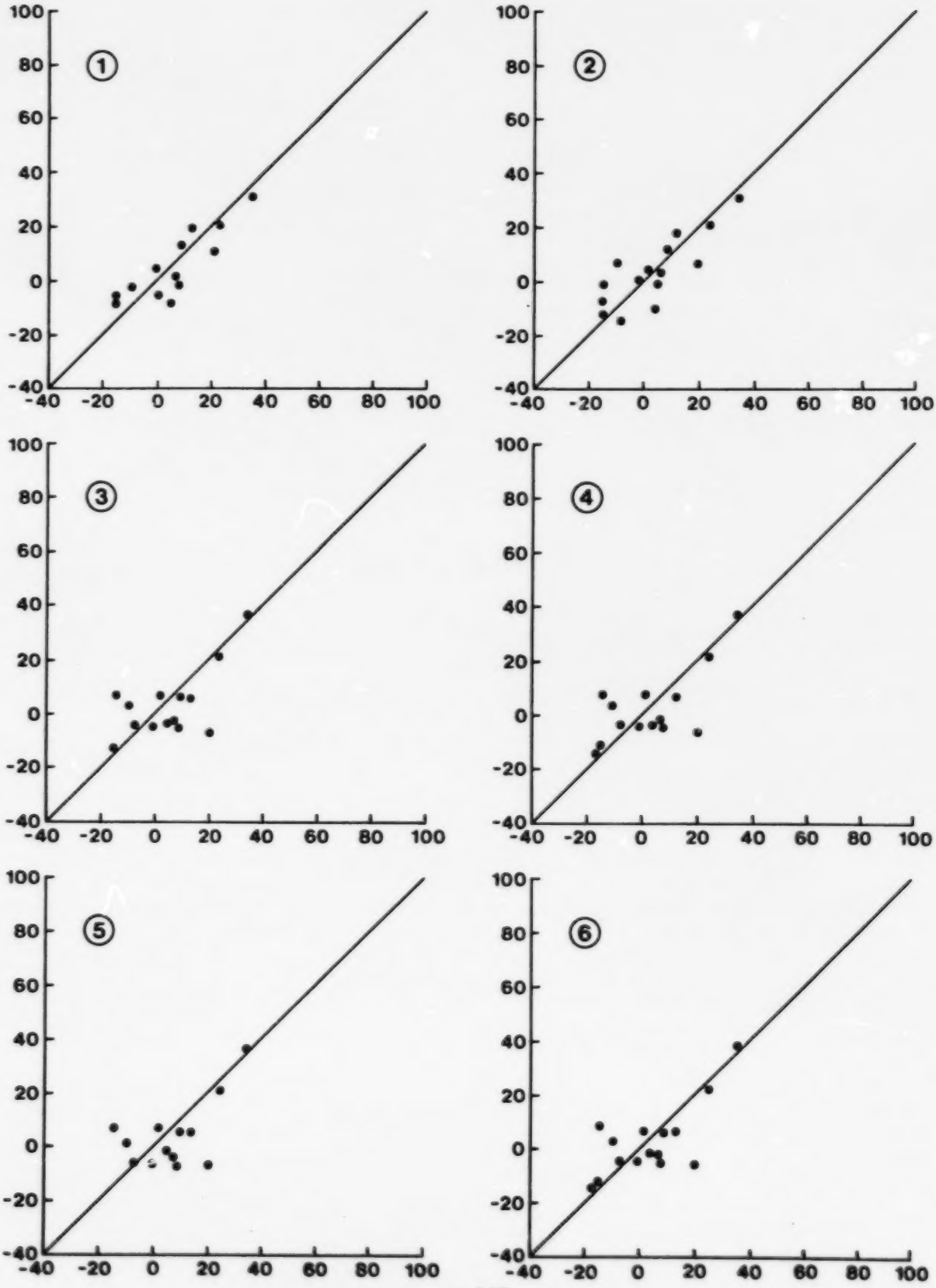
STIKINE - JUNE



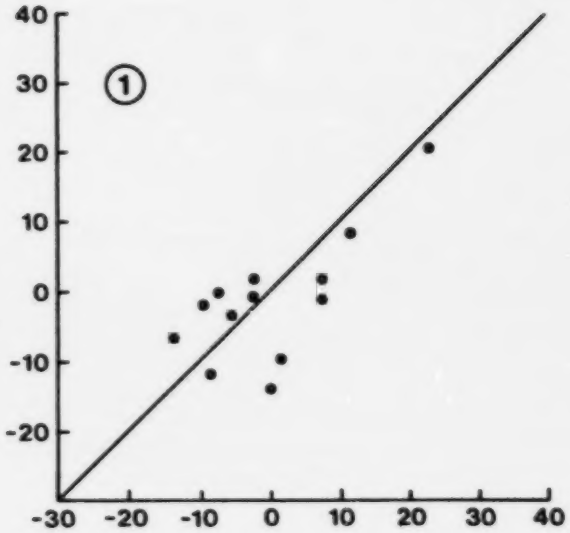
STIKINE - JULY



STIKINE - AUGUST



PEACE - MAY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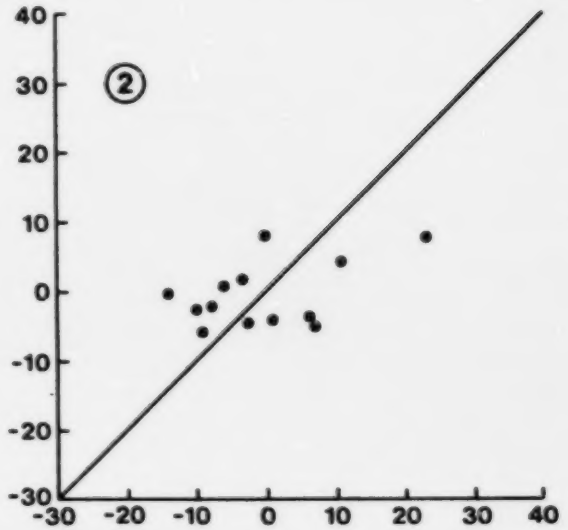
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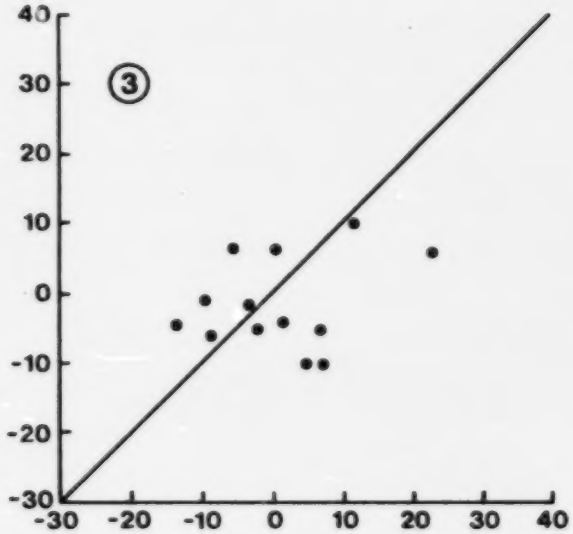
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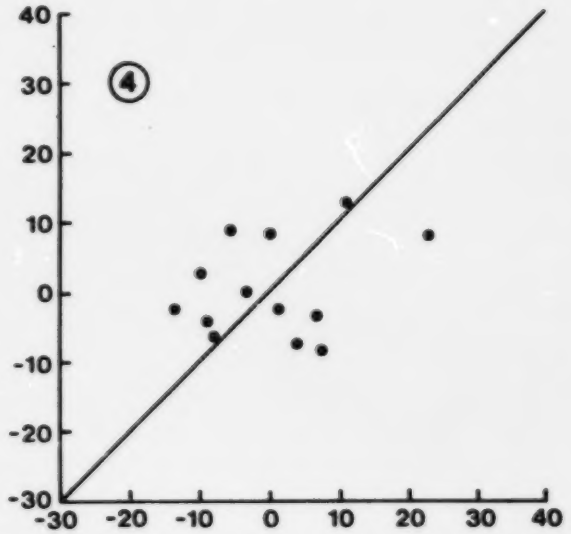
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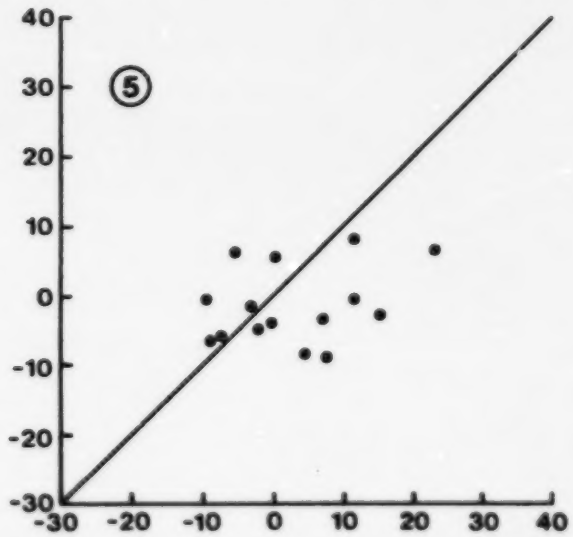
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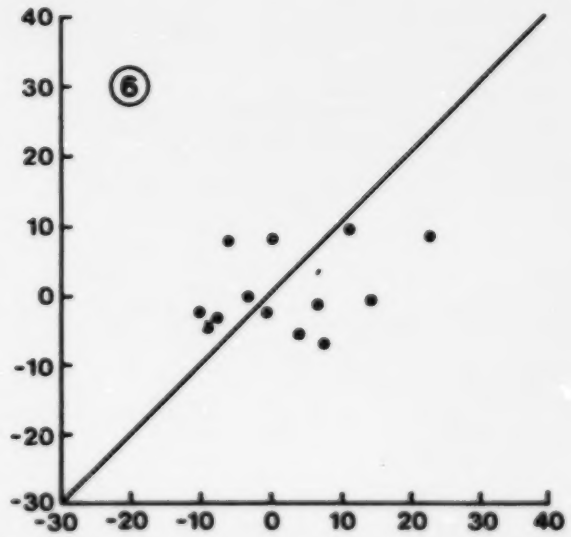
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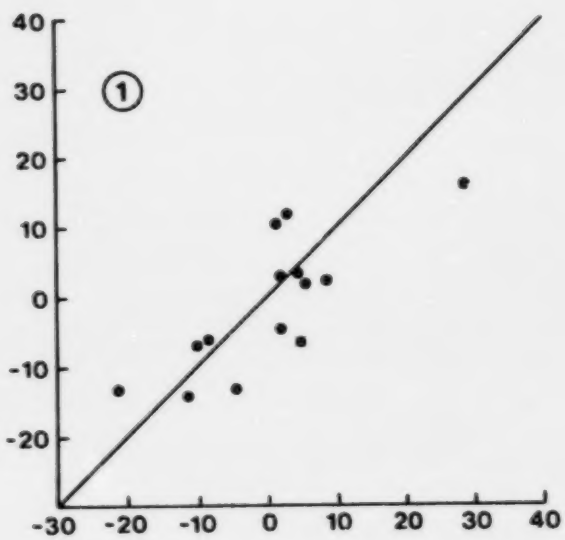
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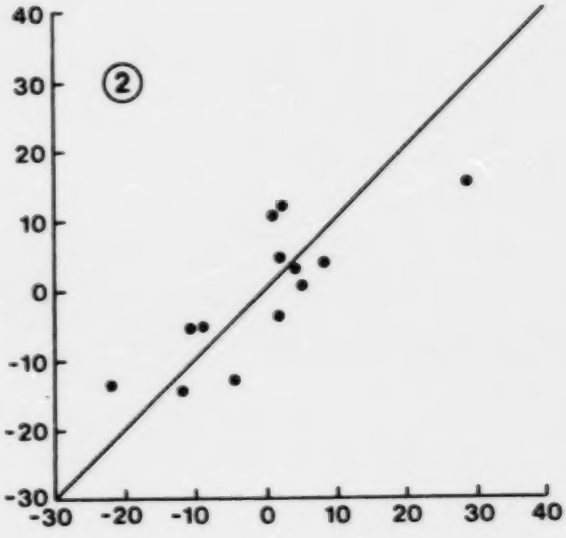
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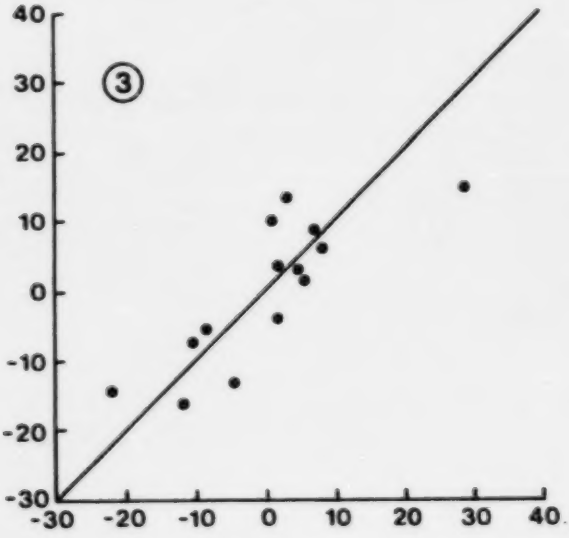
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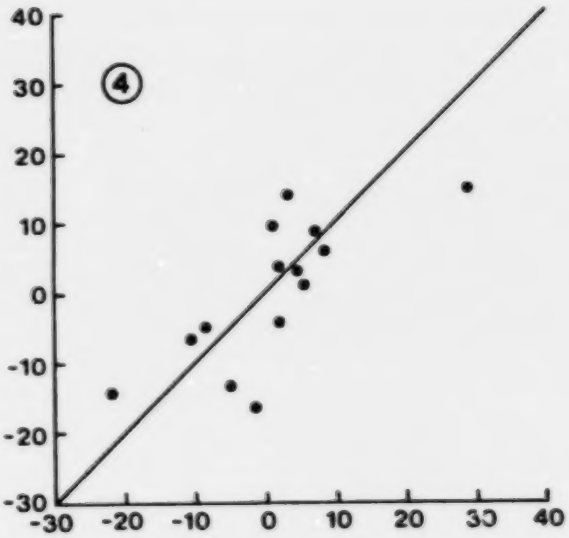
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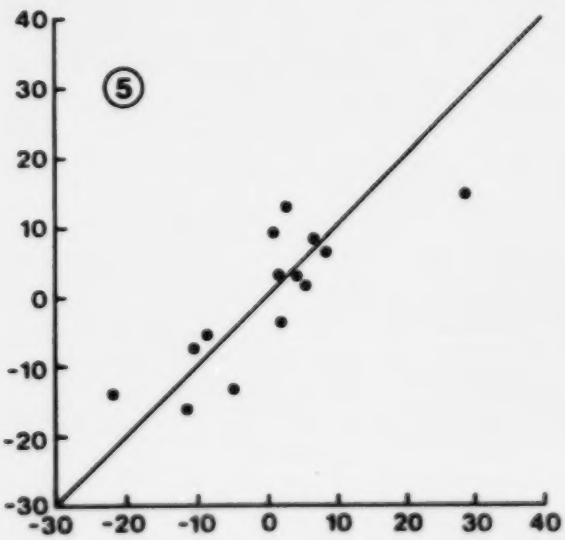
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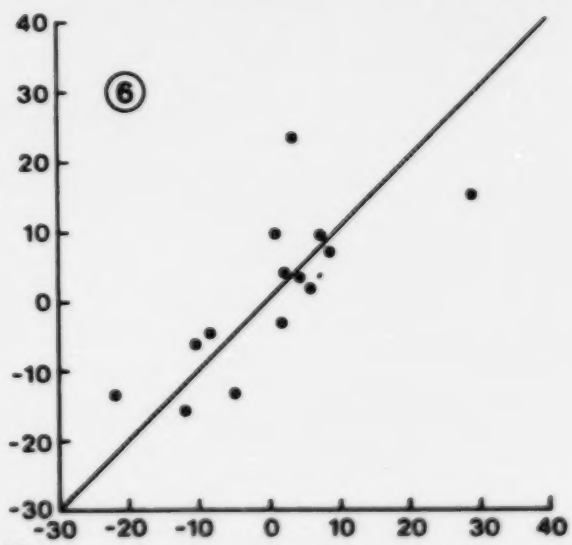
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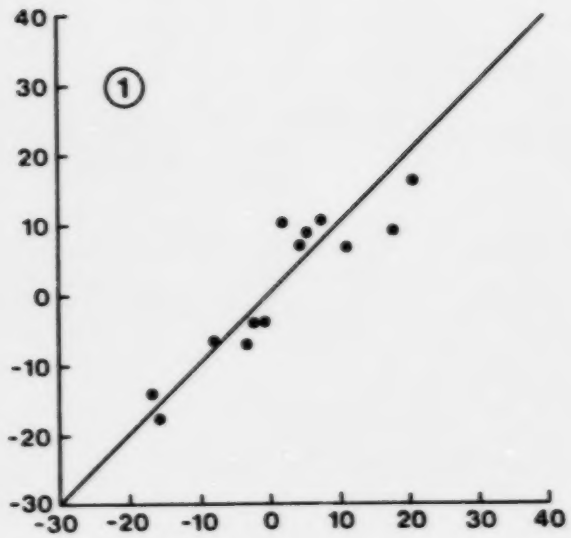
PEACE - JULY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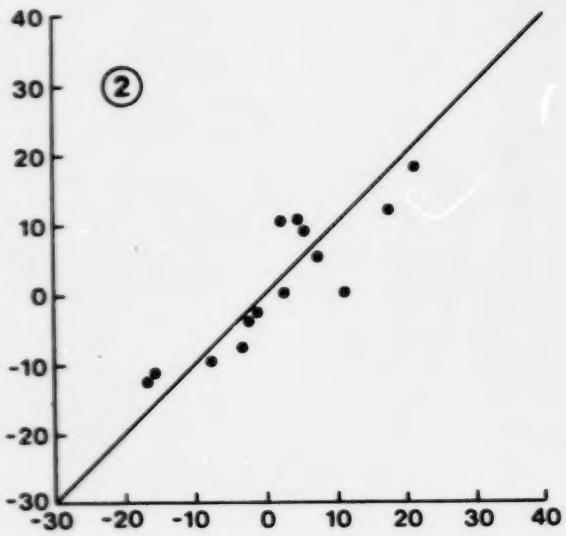
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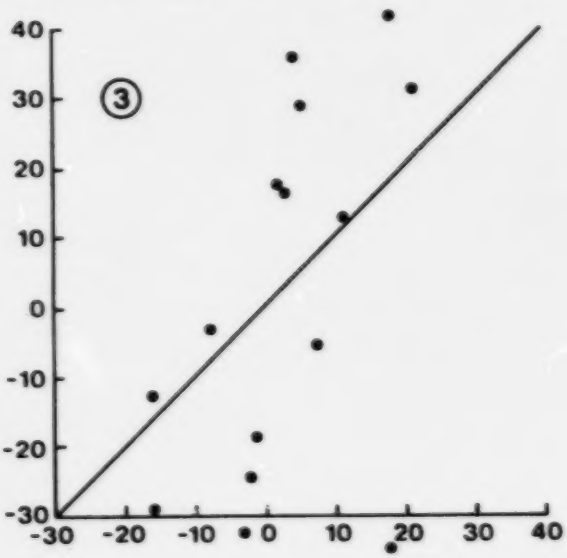
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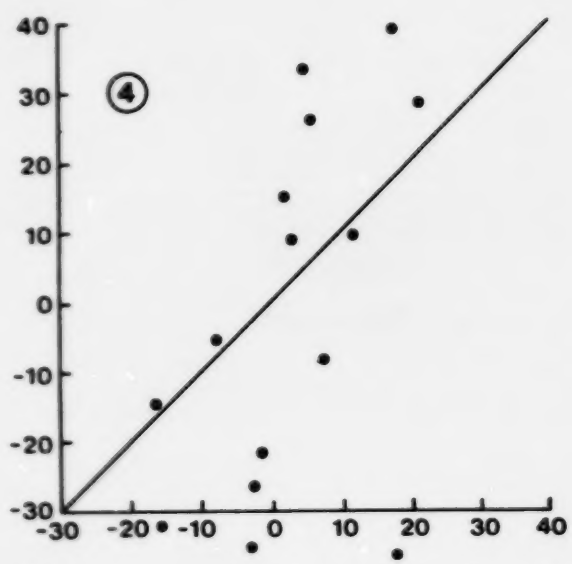
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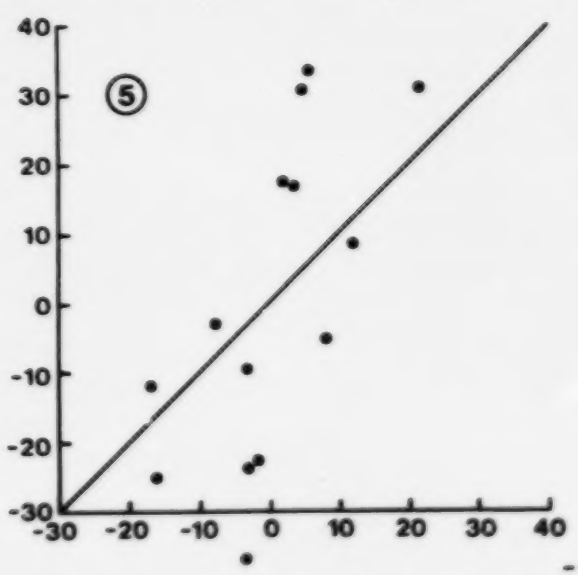
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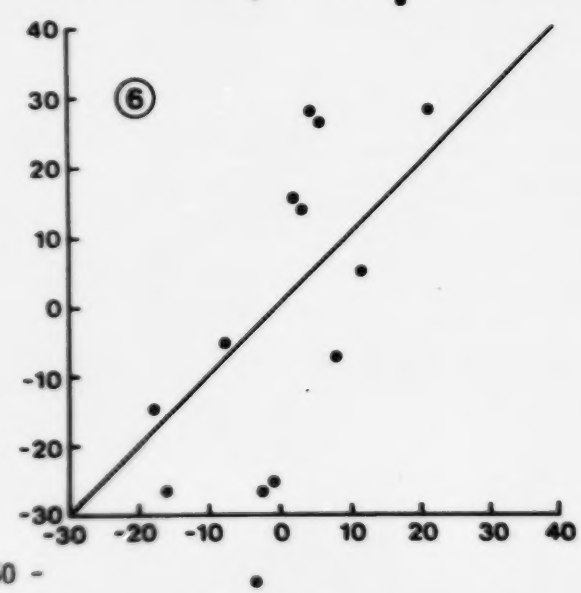
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